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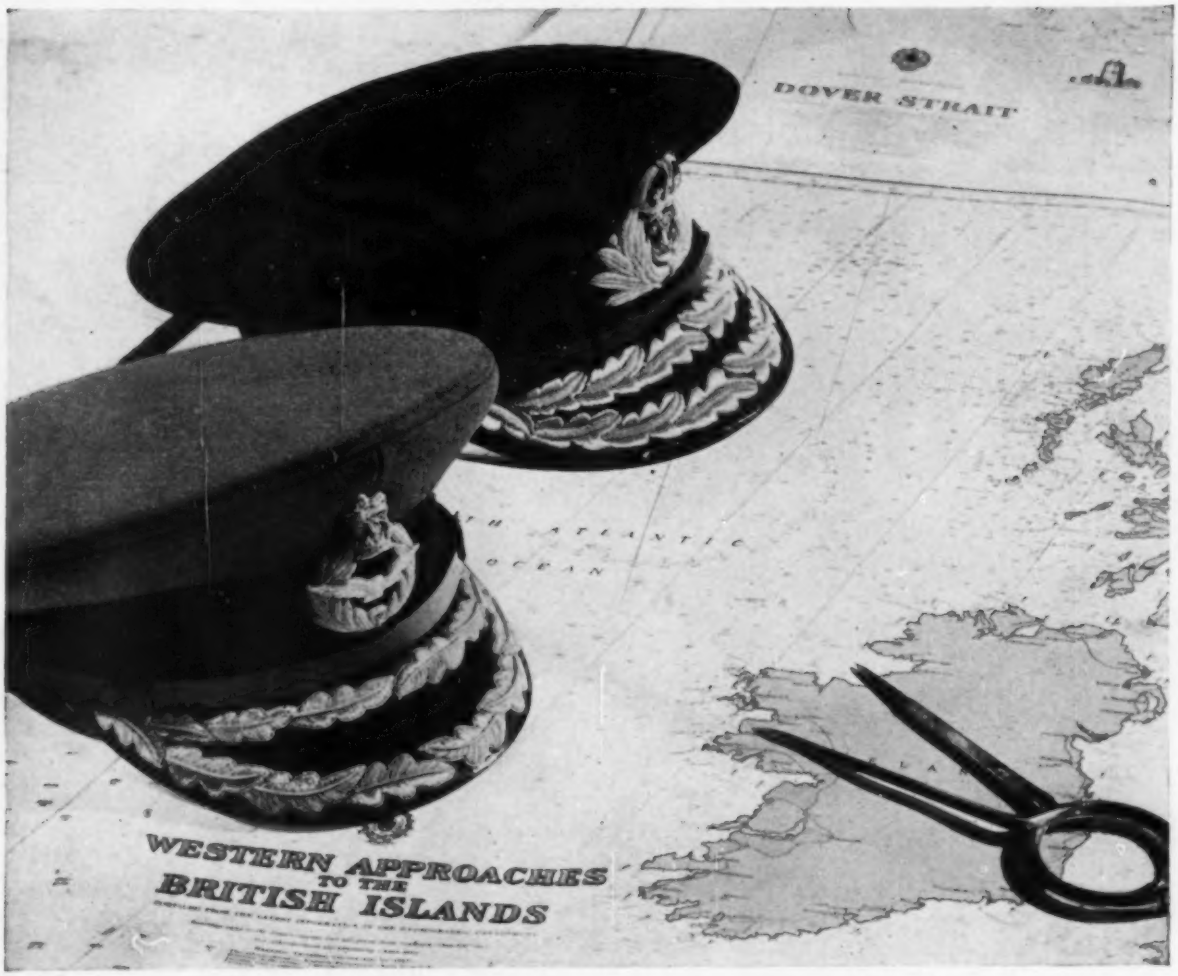

Taxes, submarines and Seamews

The submarine is now an even greater potential menace to Britain and other countries dependent on overseas supplies. This would be true whether nuclear weapons were used or not. Submarines might be the carriers of such weapons. In any event nuclear motors would greatly increase the range of submarines. Future anti-submarine operations would inevitably call for large numbers of search-and-strike aircraft, first, because coastal defence requires continuous air patrolling and, secondly, so that convoys, endangered at sea, could quickly put up an anti-submarine 'umbrella'—off improvised carriers—in any weather. In heavy weather, submarines, moving through relatively calm waters, have a mobility advantage over surface craft and are, therefore, a greater menace. Britain and N.A.T.O. countries, already heavily taxed to pay for the last war and anxious to guard against a possible next, are turning to weapons like the Short Seamew, designed for fully effective performance in action yet within a nation's capacity to build quickly, cheaply and in large numbers.

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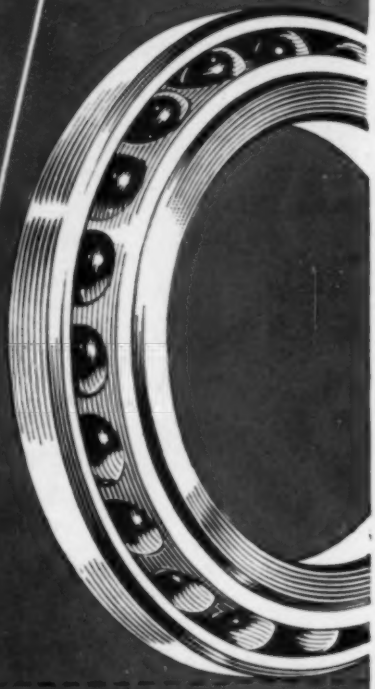

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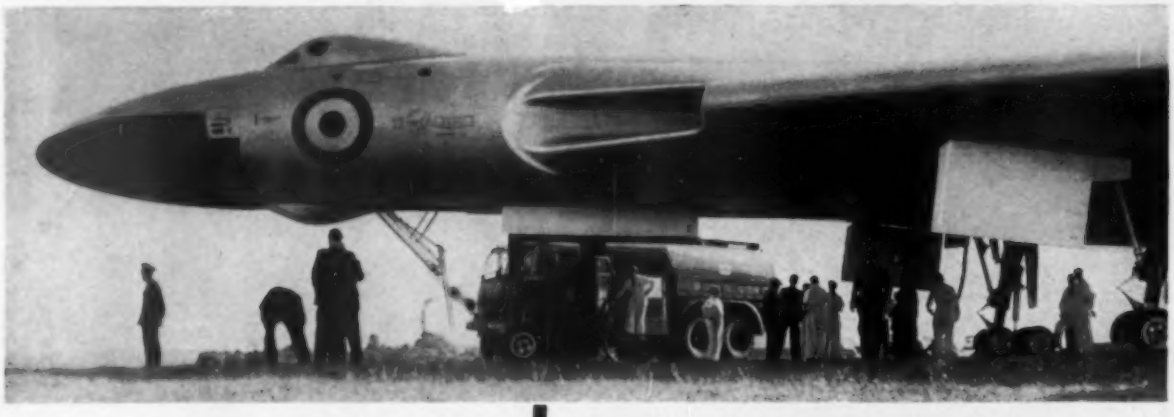

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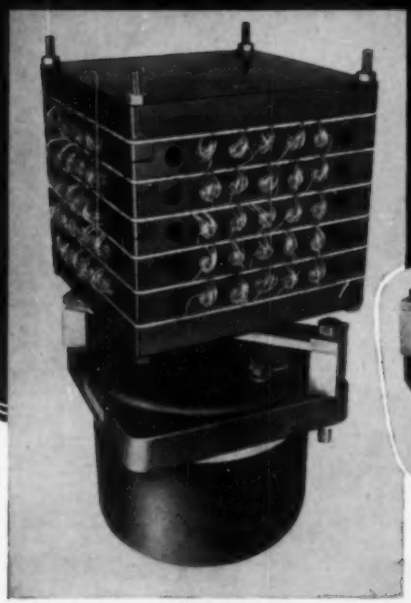
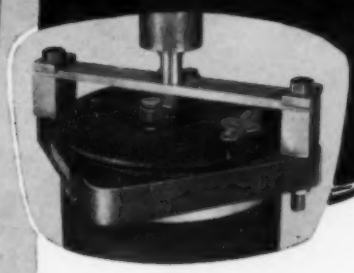
do you know...?

that a resonant beam can increase the effective 'g' applied to a test object





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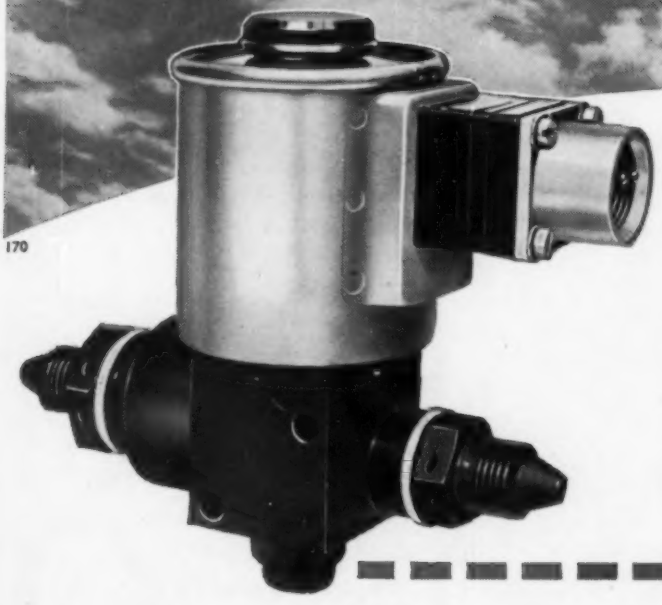

170

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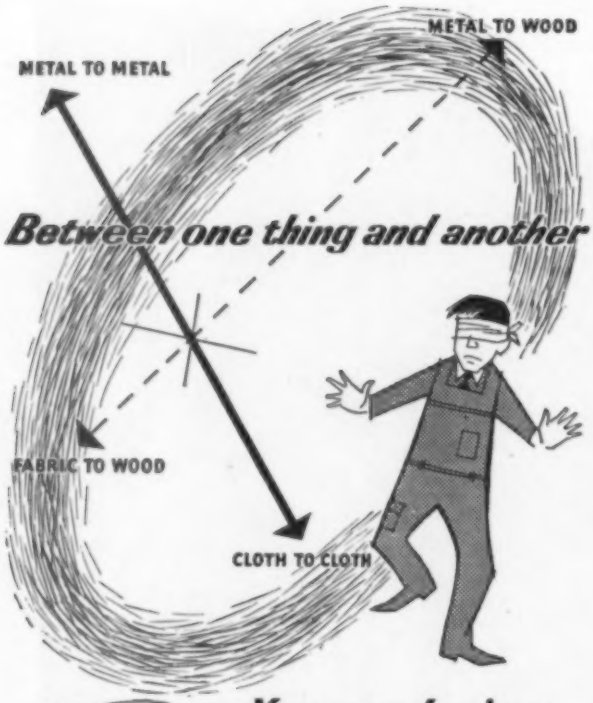
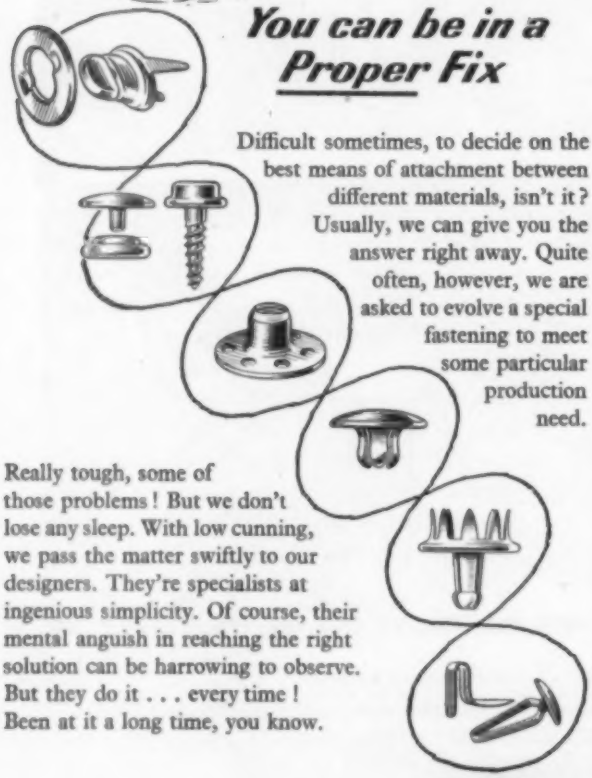


Between one thing and another



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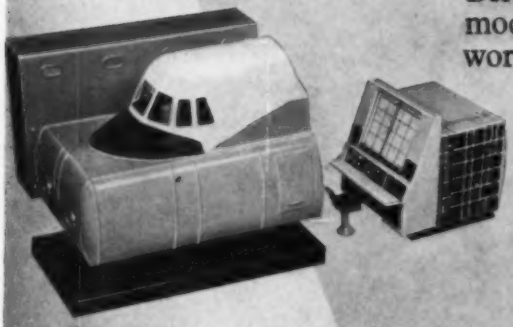
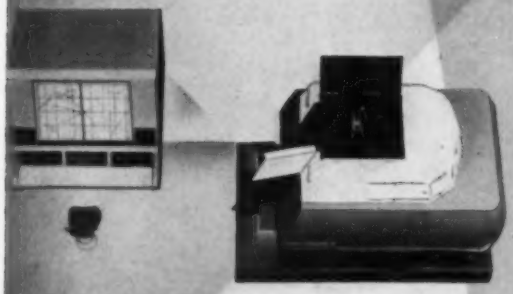
Problems of Flight Simulation?

The wide range of synthetic flight trainers manufactured by Air Trainers Ltd. results from a close study of air-line operators' and service requirements. Below are illustrated current production models on order from many parts of the world.



THE AT.100 VISCOUNT "TYPE" TRAINERS AND AT.500 RADIO AIDS UNIT.

THE FULLY ELECTRONIC SIMULATOR FOR THE HAWKER HUNTER AIRCRAFT.



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AT/53

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they will be the easiest bombers
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. . . another reason why the Vulcan is
the most effective bomber in the world

Golden Oriole photographed by Eric Hosking. Taken by high-speed flash with a specially constructed set giving 680 joules with two lamps at an exposure of 1/5,000 sec. at f/4.5.

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2452 Vol 69 FRIDAY 20 JANUARY 1956

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In this issue

69 R.Ae.S. Celebrates 90th Anniversary
71 "Promoting that Species of Knowledge . . ."
74 Germany Today
75 Flight Decks 1936-1956
76 Fleet Register
77 Four Kinds of Approach
81 Short Seamew
87 F-Boats—a Postscript
90 Aircraft and Rubber
91 —And Ceramics

Figures and Facts

WE observed recently that the Comet 3's world circuit had come as a revelation to many people upon whom the printed performance figures had made only a partial impression; and we suspect that the block speeds now promised by America's pure-jet airliners are themselves only vaguely comprehended. Certainly the funeral orations for the V.1000 took little or no cognizance of speed, with which potentiality the late-lamented British challenger would not have been over-endowed. (The estimated cruising speed, using developed Conways, was 506 m.p.h., against which must be set the 545-600 m.p.h. forecasts for the various models of the Boeing and Douglas.) It is worth noting, too, that although the Boeing 707 and the Comet 3 prototypes are flying with approximately equal thrust—40,000 lb—the Boeing is demonstrably the faster machine, though its gross weight is almost 40,000 lb greater than that of the Comet 4. Which means that the Boeing aerodynamicists have done an exceedingly fine job. As for the DC-8, the highest speed yet claimed is an all-out maximum of over 600 m.p.h.—again indicative of superb aerodynamic design, though significant in an academic, rather than a commercial, sense.

It can be argued, of course, that the operating speeds for the transatlantic versions of the Boeing and Douglas have yet to be substantiated. Indeed, the Society of British Aircraft Constructors admits only that these machines are "allegedly" faster than the Comet (adding, a shade obscurely, that the recent world flight proved "the fallacy of such an assumption"). But there can be no denying that the Boeing and Douglas long-haulers of the post-war years—and they have been the most widely accepted in the world—have generally measured up to their catalogue claims, and neither maker could expect to profit by deliberate misrepresentation.

Equally, it must be conceded that the S.B.A.C. is perfectly honest in its stated belief that the Comet is the only airliner in existence or under construction that can provide a 500-m.p.h. service over more than 2,900 miles carrying 60 first-class passengers (or, alternatively, 76 tourist-class passengers over 2,700 miles) and yet operate from existing airfields.

But, many as are the virtues of the Comet, the new Americans threaten to prove significantly faster.

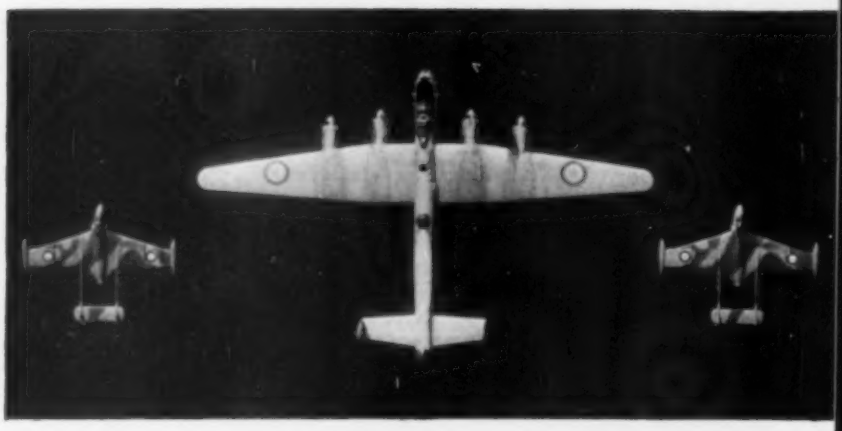
Trooping, 1956

WHAT a subject for Kipling would have been last week's airlift of troops to Cyprus—an operation for which Shackleton reconnaissance aircraft were pressed into service as troop transports. How the great man would have denounced the conditions under which T. Atkins, Esq., was obliged to travel, and how he would have flayed those whom he considered to be responsible.

In one sense at least the Air Ministry itself was perfectly right—in declaring that flying in a Shackleton is no worse than travelling in a crowded train. But why, in the name of the Prophet of Empire, should troops in this age be expected to travel in crowded, or otherwise unsuitable, vehicles? Shall we yet see the traditional *40 hommes 8 chevaux* stencilled on the Shackleton's mighty flank?

It may be allowed that the exigencies of the Service and the illiberality of the Treasury oblige the soldiery to rough it now and again; but it cannot be accepted that the Cyprus operation signifies anything but a distressing lack of military transport aircraft, even for a relatively small operation. The occasion, in fact, is one for setting down a few hard and, in some respects, discreditable facts: that Hastings are few in number and are approaching obsolescence; that, though the Britannia has been adopted instead of the V.1000, Hastings replacement is still far off; that no successor to the Valetta has been chosen—does not, indeed, exist in this country and could not for some years; and that Australia may soon order at least a squadron of new American transports.

What a desolating prospect, notwithstanding the introduction of a few Comet 2s for special duties. And what a travesty of Commonwealth defence.



COBBERS: An Australian-built Avro Lincoln of No. 1 Bomber Squadron, R.A.A.F., returning from operations against Malayan jungle terrorists, is joined by two Venoms of No. 14 Squadron, Royal New Zealand Air Force, which operates against the bandits from the same airfield at Tengah. Also at Tengah is No. 60 Squadron, R.A.F.

FROM ALL QUARTERS

Middle East Air Force Changes

PLANS for the reorganization of R.A.F. forces in the Middle East were announced in Nicosia, Cyprus, on Sunday last. Among the main features are the development of closer co-operation between units in the Middle East and in Western Europe, and the development of the M.E.A.F. into the largest R.A.F. overseas command (with an operational area of over 2,500,000 sq miles).

Air Headquarters, Cyprus, has now been absorbed into Air Headquarters, Levant, now fully operational in Cyprus after being moved from Habbaniya, Iraq, last year. In addition, Air Headquarters, Levant, will control R.A.F. units in Jordan, Iraq and Libya. A. Cdre. C. D. C. Boyce has assumed command of the Levant H.Q. with the acting rank of air vice-marshal. The same headquarters will command the northern zone of the Middle East Air Force, the southern and eastern zones being controlled from Air Headquarters, Aden, where A. V-M. I. F. Sinclair is in command. Commander-in-chief, M.E.A.F., is Air Marshal Sir Claude Pelly, with headquarters in Cyprus.

During this year R.A.F. aircraft based in Western Europe are to make increased use of Middle East flying facilities and ground organization in trials to exercise techniques of rapid reinforcement from one operational theatre to another, and the large new R.A.F. airfield at Akrotiri, Cyprus, will come into operation.

Antarctic Postponement

THE aviation element of Operation Deep Freeze—America's preparation for the Antarctic phase of the International Geophysical Year surveys during 1957-58—has suffered a sudden, if not altogether unexpected, curtailment of its activities. Last week-end it was decided that the aircraft which have been operating from the ice airstrip at McMurdo Sound, in the Ross Sea area, should suspend their survey flights and return to New Zealand as soon as possible. There was danger of the ice breaking away and carrying part of the runway—and men and aircraft—with it.

The decision to discontinue air operations until the second phase of Deep Freeze, next season, was the signal for three final long-range flights. One of them took a Skymaster on a 2,700-mile round trip over the Pole, from the ice runway to a position on the far side of the Antarctic Continent, and back again.

Altogether, Task Force 43, as it is called, numbers seven ships and 18 aircraft. The latter consist of two Lockheed Neptunes equipped with wheel-and-ski landing gear (a photograph of one of them appeared on p. 46 last week), two Douglas DC-4 Skymasters, two Grumman Albatross Triphibians (equipped for sea, snow or normal ground landings), two Douglas DC-3 Dakotas, four ski-equipped D.H. Canada Otters and six Sikorsky helicopters.

The Cyprus Airlift

IN last week's airlift to Cyprus, organized at short notice, 12,000 men of the 16th Independent Parachute Brigade Group H.Q. and of the 1st and 3rd Battalions of the Parachute Regiment were flown out in Shackletons of Coastal Command and Hastings of Transport Command. Twenty-eight Shackletons were detailed for the operation, together with 16 Hastings, the majority of the latter being used to carry the force's equipment. One of the Shackletons was struck by lightning near the English coast; the aircraft was undamaged, but returned to Blackbushe as a precautionary measure, as it was suspected that the compass had been affected.

The American Industry, 1955-56

ACCORDING to a statement by Admiral DeWitt C. Ramsey, President of America's Aircraft Industries Association, the year 1955 was marked by a greater number of significant achievements in the aviation field than any year since World War 2. In the main, this could be attributed to the acceleration and expansion of research and development resulting from the outbreak of hostilities in Korea in 1950. Progress in the military field was paralleled by significant achievements in commercial aviation. Orders totalling more than $1,000m were placed with the American aircraft manufacturing industry for jet transports, and at the year's end the transport-manufacturers' backlog of orders for all types of aircraft was at an "all-time high."

Despite the decline in unit production of military types, sales volume of aircraft, engines, airscrews, and spares was estimated at $8,400m as compared with $8,300m in 1954. This increase was due to the average weight and cost of military aircraft being greater than in earlier years; an increased amount of production effort being devoted to guided missiles; the dollar volume of commercial sales being higher than in previous years; and research and development activities having progressed at a high level. Sales of the twelve largest aircraft manufacturing companies were expected to be $4,940m for 1955, compared with 1954 sales of $4,920m.

Deliveries of military products continued to represent 85 to 90 per cent of the industry's effort. Military production averaged about 700 aircraft per month, i.e. a total of some 8,400 units for the year, compared with 1954 production of approximately 9,600 units.

More than 4,500 civil aircraft had been sold, an increase of a thousand over 1954. The major increase was in the utility aircraft field where deliveries were estimated

RED BERETS AT BLACKBUSHE: Troops of the Parachute Regiment embarking in an Avro Shackleton of No. 228 Squadron, Coastal Command, R.A.F., for Cyprus (see leading article, and news item on this page).

***HULLO THERE!** At the recent Kenya Air Show at Kitale (to be fully reported in our next issue) was a Hunting Percival Pembroke, equipped for "sky-shouting" and seen here with F/L. R. H. Anders, S/L. K. Bowhill, O.B.E., and F/L. H. Bowness, all of Eastleigh, Nairobi.*

at 4,250 units compared with 3,071 in 1954. Dollar volume of utility aircraft sales was estimated at close to $75m compared with 1954 sales of $43,400,000. Although proportionally there was a greater increase in dollar volume than in units produced, this did not reflect a great increase in unit prices. Basically, it resulted from the fact that larger and heavier aircraft, notably twin-engined types, had been in great demand, with sales of those types more than doubling the 1954 figure.

Although there was a slight decrease in the number of commercial transports delivered—from 291 in 1954 to an estimated 280 units for the past year—sales of American-made transports continued to lead all other nations.

Employment was at a fairly stable level throughout the year, averaging about 750,000 per month. Hourly earnings increased from $2.08 in 1954 to $2.19 by September 1955, and the trend was for continued increases. The total annual wages in 1955 should exceed $401,000m. If employees of larger sub-contractors and suppliers were included, the total aircraft production work force would probably be well over the million mark.

A comparison of the top five employers showed that the aircraft industry was the second largest employer. The automobile industry, with employment averaging 910,000, was in first place; steel mills, rolling mills, and blast furnaces, with 628,000 on the payrolls, occupied third position; communications equipment manufacturers were fourth with 502,000; and manufacturers of cotton and rayon fabrics fifth with 467,000. The aircraft manufacturing industry was the largest single employer of engineers and scientific talent, and one out of every eleven workers in the aircraft industry was employed in engineering activities compared with the one to twenty-five ratio of World War 2.

During 1956 dollar volume of sales was expected to exceed again the $8,000m mark despite the anticipated continued decline in unit deliveries of military aircraft. An estimate of military production would be slightly less than 8,000 units. From the standpoint of total industry effort, however, the military aircraft production decline would be largely offset by increased deliveries of guided missiles.

At the end of September 1955 the industry had unfilled orders on their books in the amount of $13,900m as compared with a backlog of $14,900m at the end of calendar year 1954. In part, the decline in the industry's backlog was explained by delay in the placement of orders for new military aircraft during the past year.

American Transports for R.A.A.F.?

THE Australian Government may soon place an order in the United States for at least a squadron of medium transport aircraft. They are needed to replace Dakotas, and they will not be Convair 440s, two of which type were recently acquired. They might well be Fairchild (Chase) C-123s. It is reported that the R.A.A.F. is anxious to standardize its transport squadrons on American aircraft, as it believes that supplies would more easily be obtainable in time of war from America than from Britain.

Pipers for New Zealand

ACCORDING to a Wellington, N.Z., correspondent, the New Zealand Government has approved the importing of 24 Piper aircraft at a cost of "at least £70,000." One of the machines is a twin-engined Apache which will be employed by the Civil Aviation Administration for inspecting airport facilities throughout the Dominion. Of the remainder, 17 will be used in agricultural work. Before receiving a New Zealand C. of A., adds our correspondent, they will be modified to enable them to jettison their load in 5 sec.

St. Clement Danes Appeal

FURTHER details of the plan to rebuild the church of St. Clement Danes, London, as a central church of the Royal Air Force have been given by the Air Ministry. An appeal for £125,000 towards the project has been launched; other sources contributing to the cost are war-damage payments and the Pennington-Bickford bequest.

The church as known today was built by Christopher Wren in 1680-82, the Gibbs steeple being added in 1719. In 1941 it was hit by incendiary bombs during a German air raid and was gutted, only the shell of the building remaining on the church's island site in the Strand. By agreement between the Diocese of London and the Air Council, the church is now to be restored, to Wren's design, for the use of the R.A.F. and its associated forces.

The names of more than 125,000 British, Commonwealth, Allied men and women who died on active service with the R.A.F., W.R.A.F., R.F.C., and R.N.A.S. will be commemorated in ten Books of Remembrance, which are to be placed under the ten aisle windows of the chancel and nave, and which will form a complete roll of honour The heraldic badges of R.A.F. Commands and squadrons are to be incorporated in the floor of the nave.

The famous "oranges and lemons" bells of St. Clement's were, with one exception, severely damaged in the fire of 1941, but it has been found possible to recast them. The 1588 Sanctus bell, the oldest, was the only one to escape damage, and it will be returned to the church in its original condition.

Donations towards the restoration fund should be addressed to The Hon. Treasurer, St. Clement Danes (R.A.F.) Appeal Fund, Lloyds Bank, Ltd., 222 Strand, London, W.C.2.

Fastest Turboprop Transport

THE first of two Lockheed YC-121F Super Constellations has been delivered to the U.S.A.F. and has begun its crew-training programme. Powered by four 5,700 h.p. Pratt and Whitney T34s, the YC-121F can cruise at more than 420 m.p.h. and could carry, it is claimed, 32,000-lb loads non-stop from London to Dakar (2,800 miles) in 7 hr. Maximum loads are 106 passengers or 36,000 lb of cargo. Two sister aircraft, designated R7V-2, are now being flight-tested prior to delivery to the U.S. Navy.

Radio-Sonde at 103,000ft

NOW being tested by the Meteorological Office, a new type of radio-sonde balloon is reaching average heights some 30,000ft greater than those achieved by present standard balloons. The highest altitude so far recorded is 103,000ft (about 19¾ miles). The balloons carry instruments which provide observations of pressure, humidity, temperature and wind force in the upper atmosphere, and are equipped with radar reflectors to assist in tracking. Since last autumn four have been released daily—two from Leuchars, Fife, and two from Crawley, Sussex—and trials are still progressing. The average height reached by nearly 200 balloons has been 80,900ft and eight have ascended to more than 100,000ft. More important still, the balloons have shown a marked consistency and few of them have burst before reaching useful heights.

Diameter is 7ft and weight 44 oz, whereas the older type measured 6ft in diameter and weighed 17¼ oz. Experiments with even larger balloons, weighing 70 oz, have indicated that merely to increase the size without careful consideration is disproportionately expensive and results in a slower rate of ascent.

B-57s in Japan

THE commander of the U.S. 3rd Light Bombardment Wing, Col. Cecil P. Lessing, has stated that the Martin B-57s (English Electric Canberra licence) recently arrived in Tokyo would have as their war-task the destruction of the enemy airfields now being built for Communist jet fighters and bombers. When conversion from B-26s is completed, added the colonel, the Tokyo force will have 45 of the new jet bombers. Col. Lessing is also on record as saying that in the Far East the Western air forces were outnumbered by two to one by Communist forces, though despite this situation the striking power of the West was far greater because of superior training and better equipment.

National Air Races, 1956

DATES of this year's National Air Races, announced by the Royal Aero Club, are: first and second rounds, Whit Monday, May 21st, at Yeadon Aerodrome (in connection with Yeadon Aero Club); third round (including King's Cup Air Race), Saturday, July 21st, at Baginton Aerodrome, Coventry (in conjunction with

FROM ALL QUARTERS . . .

Coventry Corporation). The second British Lockheed International Aerobatic Trophy contest will take place at Baginton on July 20th and 21st. No details have yet been given concerning the number or the classification of the races.

Commemorating Bréguet's Work

A HANDSOME trophy in commemoration of the French aviation pioneer Louis Bréguet, who died last May, and much of whose work was devoted to rotating-wing flight, has been presented to the Royal Aero Club by Sir Richard Fairey, chairman and managing director of the Fairey Aviation Co., Ltd. It is to be awarded annually "for meritorious achievement in the development of any form of aircraft that substantially achieves the advantages offered by rotating-wing aircraft" —in other words, it may be assumed, any type of machine capable of good performance independent of forward speed.

Sir Richard Fairey's trophy.

The trophy is to be awarded to a company, or individuals or group of individuals (such as inventors, technicians or aircrews) provided that the recipient is either a subject or a registered organization of the British Commonwealth or of France or her possessions. The Aero Club de France will be asked to submit to the Royal Aero Club by January 31st each year its recommendations as to possible French recipients.

Technical requirements stipulate that the aircraft concerned must be a heavier-than-air machine capable of taking off in still air at a speed not exceeding 30 km/hr (18.64 m.p.h.) at full normal load, maintaining sustained flight, and landing at a speed not exceeding 30 km/hr in still air. The award will be open to F.A.I. classes C (aeroplanes), E (rotorcraft) and H. Details of the new category H are not yet available, but they are expected to take account of V.T.O. aircraft.

The trophy, illustrated here, is a silver statuette of Daedalus and Icarus, the two figures famed in Greek mythology for their attempt to fly with wings made of feathers and wax. The trophy is not a new one, yet its previous history is completely unknown. It was made by Mappin and Webb before the First World War but the details of its history and original purpose were destroyed, with other records, by enemy action in 1940-41.

The Hawker Siddeley Year

IN his speech to shareholders at the annual general meeting of Hawker Siddeley Group, Ltd., in London on January 11th, Sir Thomas Sopwith (chairman) said that the year ended July 31st, 1955, had been another successful one and that the profits of the group, after deducting reserve for increased replacement cost of fixed assets but before taxation, had amounted to £11,675,537 as compared with £6,976,354 in the previous year.

"There are those who will disapprove of the apparently large profits disclosed by these accounts," said Sir Thomas. "To them I would say this: Our profits are a reflection of excellent workmanship and efficient management, and they represent only a moderate return on the greatly increased turnover of our operating companies in their varied activities at home and abroad.

"If this country is to overcome difficult economic conditions in the future, industry must continue to make profits and to plough back the major part of them in order to finance development and research." This has always been the policy of the directors, continued Sir Thomas, and this year, despite the heavy burden of taxation, which was estimated at £7,146,794, they had been able to leave £4,360,989 of the year's profits in the subsidiary companies, where it would be used "to finance expenditure on new assets and in the development and scientific research so vital to our future."

The chairman went on to say that consent had been received from the Treasury to capitalize £11,644,700 of the group's reserves. An extraordinary general meeting would be held on January 25th at which resolutions would be presented to increase the authorized Ordinary share capital by £12m and to apply capitalized reserves in paying up in full unissued Ordinary shares of £1 each, to be allotted in the proportion of one new share for each Ordinary share held.

The chairman's review of the year's activities did not, so far as the aviation side was concerned, disclose any new development not already reported, though it is worthy of note that, in speaking of the progress of the Canadian companies, he remarked that Avro Aircraft was engaged in research and development of "a revolutionary new aircraft design conception." This suggests that work has been resumed on the so-called "flying saucer" project, which was at one time reported to have been either postponed or abandoned.

Of Hunter progress, Sir Thomas Sopwith said that large numbers were now in service with the R.A.F., first deliveries to Sweden had started, deliveries to Denmark would soon begin, and a contract had been signed with the Peruvian Government for deliveries to begin this spring. Components had also been supplied to Holland and Belgium, where the aircraft was being built under licence.

At the end of Sir Thomas's speech a shareholder asked if there was "anything cooking" in regard to a civil aircraft—it was said two years ago, he believed, that the company were working on a civil version of the Vulcan. Sir Thomas replied: "That is one of the questions which I am sure you will realize is constantly under review by the Board. I would not say it has been dropped. It certainly has not been dropped. I hope in time we shall find our way into the civil market."

The chairman's statement was issued to shareholders in advance of the meeting, in the form of a most handsomely illustrated 32-page brochure in full colour, illustrating every facet of the group's activities. Though already having a fair idea of its activities outside aviation, we were surprised at the scale on which some of the companies are operating—particularly the vast numbers and size of the Canadian Car and Foundry Company's rolling stock and road transport products; and, again, the scale on which Hawksley S.M.D. are now building "traditional houses by new constructional methods." From the same company, too, come such products as cranes and television transmitter masts.

Porous Solution

AIRCRAFT which "perspire" may prove to be the answer to heating problems at supersonic speed, according to Mr. C. E. Pappas, chief of aerodynamics and thermodynamics at the Republic Aviation Corporation. Mr. Pappas said in New York recently that he believed that within two years aircraft could be flying at a Mach number of 4 at 50,000ft, under which conditions the airframe surfaces would heat to 900 deg F. in not much more than a minute's flying time. For such speeds, he said, new metals would be used—and so might "transpiration." For example, water could be forced out through pores in the skin, being emitted as steam and carrying off a good deal of the heat. Mr. Pappas added that aircraft flying at 100,000ft at a Mach number of 10 could become a reality in five years if appropriate structural materials and powerplants were developed. Temperatures at such speeds would be about 3,000 deg F, and flight could last no longer than five minutes because of fuel and temperature limitations.

Ceylon Survey Progress

THE Lockheed Hudson which the Photographic Survey Corporation of Toronto will use in the forthcoming aerial photographic survey of Ceylon has left Oshawa Airport for that country. The Hudson will be employed in photographing the whole of the island (over 25,000 sq miles), as a basis for the integrated air/ground resources survey described in *Flight* of November 11th, 1955. The project is being carried out under contract to the Canadian Government as part of the Colombo Plan.

The aircraft, piloted by William MacLarren, is flying to Colombo via Newfoundland, the Azores, Portugal, Spain, Italy, Greece, Malta, Lebanon, Iraq, Oman, Pakistan and India. Other crew-members are R. Nymark, navigator; L. Hollinger, flight engineer; and N. R. Hislop, camera operator. Already in Ceylon, where advance preparations for the coming survey have been made, are Mr. J. M. Henderson, project manager (previously project manager of the P.S.C. survey in Pakistan), and Mr. H. Woodward, chief photographer.

"Flight" photographs

Top photographs (left to right): Mr. N. E. Rowe delivering his presidential address; Sir Roy Fedden proposing the vote of thanks; and Capt. Laurence Pritchard seconding. Centre: (left) Dr. A. M. Ballantyne, R.Ae.S. secretary, with Mr. and Mrs. L. A. Wingfield at the reception; (right) Lord and Lady Sempill being received by Mr. and Mrs. Rowe. Bottom: (left) Mr. and Mrs. W. E. W. Petter; (centre) Sir Sydney and Lady Camm with Mr. and Mrs. George Edwards; (right) Mr. and Mrs. George Dowty talking with Lord Sempill. Mr. Dowty made the first contribution to the new Centenary Fund by writing a cheque for £100 immediately the fund had been announced.

R.Ae.S. CELEBRATES 90th ANNIVERSARY

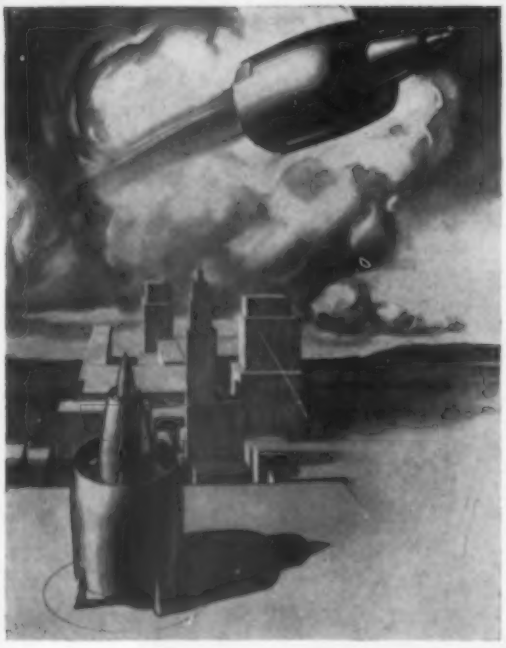
THE 90th anniversary of the founding of the Royal Aeronautical Society was celebrated on Thursday, January 12th, at the Royal Institution, London, where the photographs on this page were taken. Following the presidential address by Mr. N. E. Rowe (reported on pages 71-73), an anniversary reception was held at which Mr. and Mrs. Rowe welcomed members and their guests.

The chairman of the presidential-address meeting was Lord Sempill, chairman of the Society in 1926-27 and president from 1927 to 1930, who referred to the present serious shortage of scientific and technical manpower. The Government had not done enough in this respect, he said, and there was a great opportunity for the Society here. A vote of thanks to the president was proposed and seconded by Sir Roy Fedden (president 1944-45) and Captain Laurence Pritchard (secretary 1925-51) respectively.

In forthright terms, Capt. Pritchard criticized the Society's Council and members for their lack of enthusiasm. He agreed with Mr. Rowe that a presidential address was good for the president as well as for the Society; he (the speaker) had served under 17 presidents, "a lot of whom needed a lot of good doing for them." Public opinion of the Society should be high, but was not: relevant criticism had been made by Sir Roy Fedden at the recent Production Conference and by the speaker in his 1953 Pierson memorial lecture at Weybridge.

"As a member of 37 years' standing," Captain Pritchard continued, "I do not think members are doing their job." Attendance that evening was very poor, and "you have got a damn bad Council because of the damn bad membership." An adventurous leadership was required; members must wake up and realize the importance of aeronautics; and the Society should strive to achieve a truly independent position. It was not sufficient to "think of a member, and double it"—a mere increase in membership numbers was of little use.

HERE AND THERE



RING WING: Immediately suggestive of the French B.T.Z. coleopter is this projected Kaman annular-wing aircraft, for which the U.S. Office of Naval Research has awarded a research contract. As this artist's impression suggests, it is designed to rise vertically and cruise horizontally.

Florida-launched Satellite

THE first American earth satellite is to be launched from Patrick Air Force Base, Cocoa, Florida, where there is already a missile test centre.

Migs Supplied—

PART of a formidable consignment of arms recently received by Egypt from Czechoslovakia, two squadrons of Mig fighters flew over Cairo for the first time on January 15th.

—but not Harvards

THE Egyptian Ambassador to Canada, Mr. El Husseini El Khatib, speaking in Ottawa on January 13th, described as "absolutely false" reports that 25 Harvard trainers had been shipped from Canada to Egypt.

Palace Appointment

IT has been announced from Buckingham Palace that S/L. H. M. Chinnery, A.F.C., is shortly to be appointed Equerry to the Duke of Edinburgh in succession to W/C. Beresford Horsley, M.V.O., A.F.C.

Bristol to Stockholm

AT the invitation of the Swedish Royal Institute of Technology, Dr. S. G. Hooker was delivering a lecture in Stockholm last Tuesday on *Modern Powerplants for Aircraft*. He is a director and chief engineer of Bristol Aero-Engines, Ltd.

R.A.A.F. Canberra Trainers

PILOTS and navigators of the Royal Australian Air Force were to leave Adelaide on Wednesday of this week for the United Kingdom. They will ferry back two of nine English Electric Canberra T.4 dual-control trainers for the Australian Government.

PRIVATE EYE: Senior officers of Scotland Yard and H.Q. Western Command recently saw a demonstration of air-to-ground TV from a Bristol Sycamore helicopter. Mr. J. G. M. Downs, Pye technical representative discusses the camera installation with (l. to r.) S. Wheal, N. Dark and J. Bigwood.

Sea Hawks for Dutch Navy

THE Royal Netherlands Naval Air Service will receive 30 Hawker Sea Hawks—the first jet aircraft to be acquired by this Service—under M.D.A.P. Two squadrons will be formed and embarked in the carrier *Karel Doorman*, now being rebuilt.

The Graphic Mind

THE aircraft industry's need for illustrators capable of improving the presentation of technical information was referred to by C. Baker, A.R.Ae.S., technical publications manager of Handley Page, Ltd., when he addressed members of the Technical Publications Association at University College, London, on January 10th. The sequence of assembling an intricate mechanism was often difficult to describe in words alone and illustrations were essential to simplify the explanation.

CAPT. M. LUBY, R.N. (Ret.), who has been appointed vice-chairman of Rotax, Ltd., following the retirement of Mr. C. H. Dutton, C.B.E., from routine activities. Capt. Luby retains his post of general manager.

R.Ae.S. Prize for Cranfield

A NEW annual award, the Royal Aeronautical Society Prize, is to be made to the best student in any one department at the College of Aeronautics, Cranfield. The prize, of £10 value, has been donated by the Society and will be awarded for the first time at the end of the current academic year.

America's Spanish Bases

THE American Under-Secretary for Defense, Mr. Robertson, stated at a Press conference in Madrid recently that the American air bases in Spain will be far enough advanced to be used "in case of emergency" towards the end of this year.

R.Ae.C. Film Show

THE next film show at Londonderry House for Royal Aero Club members and their guests will be on Thursday, January 26th, at 6.15 p.m. The programme will consist of *Finland with Blue-White Wings*, a film loaned from Finnair; *Northern Lights*, an Arctic air route survey film; and films of the 1931, 1933 and 1934 R.A.F. Displays.

Insurance Appointments

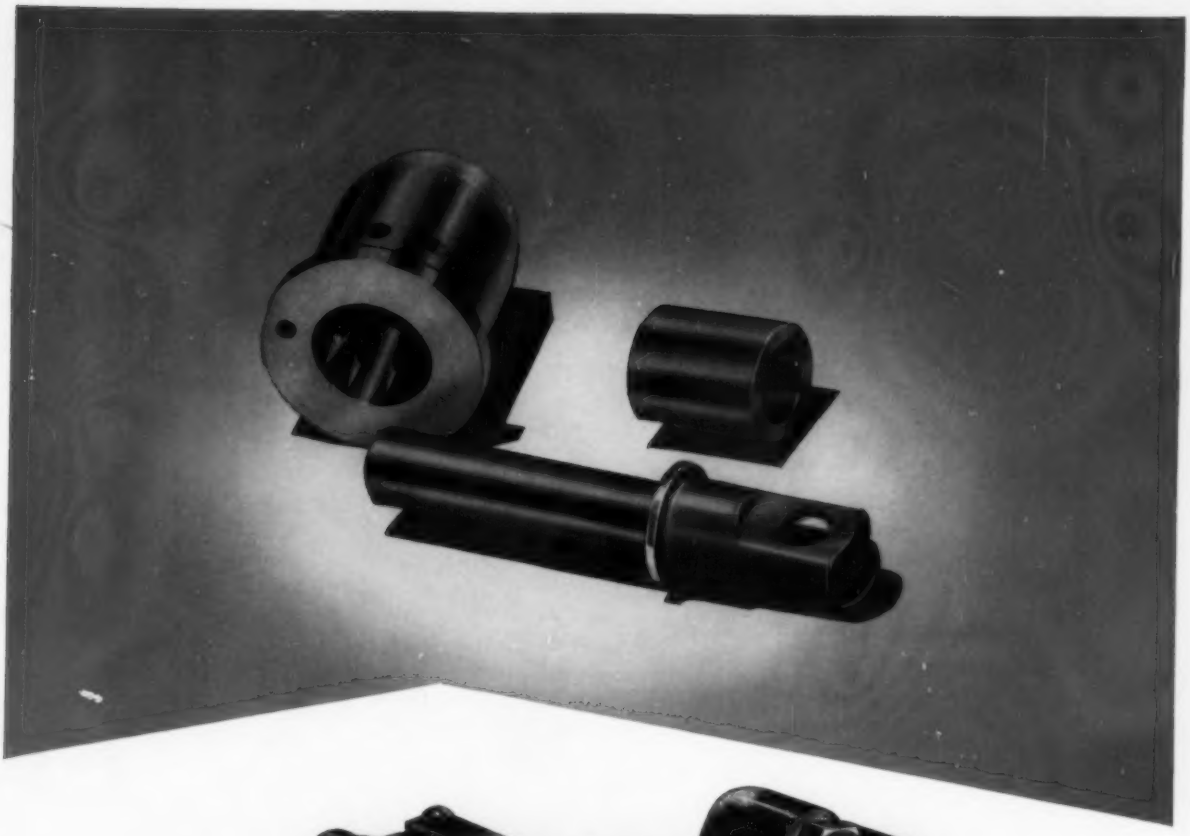
THE directors of the British Aviation Insurance Co., Ltd., announce that Mr. K. J. Anderson has been appointed chief technical officer of their air safety and survey division, and Mr. H. Caplan assistant chief technical officer.

Space Speaker

GUEST speaker at the next meeting of the London Society of Air Britain (7 p.m., February 8th, Caxton Hall) will be Mr. Patrick Moore, F.R.A.S., F.B.I.S., the astronomer and author, whose subject will be *The Conquest of Space*.

Yorkshire Recognition Contest

TWENTY-EIGHT teams competed in the annual recognition contest of the York Aviation Group, held at No. 20 Group, R.O.C. headquarters. Thirty slides were shown for one second each and the ultimate winners were Y.A.G. "A" team, with Y.A.G. "B" team and Guisborough/Smeaton R.O.C. tying second. Individual results were: 1, H. Heard; 2, I. Evans; 3, P. Cox.



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"Promoting that Species of Knowledge . . .

. . . *which Distinguishes the Profession of Aeronautics*": *R.Ae.S. Presidential Address by Mr. N. E. Rowe*

The entrance to the Royal Aeronautical Society's headquarters at Hamilton Place, London, W.1.

A WIDE review of the Royal Aeronautical Society's contribution to the development of British aeronautics was given at the Royal Institution on Thursday, January 12th—the Society's 90th anniversary—by the R.Ae.S. president, Mr. N. E. Rowe, C.B.E., B.Sc., D.I.C., F.R.Ae.S. After tracing the history of the Society and its place in British aviation, Mr. Rowe concluded by discussing the present and future rôles of the Society. A centenary fund was to be set up, he disclosed, with the object of acquiring new headquarters premises by 1966.

Detailed extracts from the presidential address are given below.

So far as I can trace [Mr. Rowe began] this is the third presidential address presented before the Society. The previous ones were both given by great men in aeronautics, the first in January 1903, by Major Baden-Powell (president 1900-1907), and the second in April 1937, by Mr. H. E. Wimperis (president 1936-1938). Major Baden-Powell, just home from the South African War, reviewed the then state of aeronautics; he was well qualified to do so having been elected a member of the Society in 1880 and served as its honorary secretary since November 1896. He founded the *Journal*, offering to publish it at his own expense and risk; in fact the Council, when he went abroad in 1899, recorded that as honorary secretary he had virtually re-established the Society. His membership continued for 57 years; this Society and aeronautics owe him a great debt.

Mr. Wimperis spoke on *The Natural Limits to Human Flight* and his address is well worth reading today. He was the first Director of Scientific Research in the Air Ministry, and laid the foundations for the research organizations and work which has made and continues to make such a vital contribution to aeronautical advance. He, also, gave great service to this Society.

As the third in this line I feel quite unworthy; however I find great encouragement in recollecting that this is an extremely interesting and important date in the annals of our Society, since it is of the Society that I wish to speak. It was on January 12th, 1866, that a number of men interested in aeronautics came together at the house of the Duke of Argyll for the purpose of founding a Society " . . . for the advancement of aerial navigation and for observations in aerology connected therewith." The Duke of Argyll was elected president, a post which he filled for 29 years. The Duke of Sutherland, Lord Richard Grosvenor and Lord Dufferin were elected vice-presidents. The Council included famous scientists and engineers of the day and a number of them continued to serve on the Council for many years. In particular, the honorary secretary, Mr. F. W. Brearey, who had been very active in promoting the Society, remained to do most valuable work as honorary secretary until his death in 1896.

The first point to note, I think, is that all concerned were amateurs in the science and art of aerial navigation which we now call aeronautics. Men of great vision, many of them, and quite prepared to stand up to very solid criticism and even derision because they believed in this new science. Of course at that time there had been many balloon ascents and James Glaisher, F.R.S., of the Council, made some of the greatest; but amongst those who were elected were a number who believed that the real future of aeronautics lay in heavier-than-air machines. In fact Mr. Wenham, one of the members of the Council, in the first address given to the Society in June 1866, gave some penetrating views and theories about the forces acting on plane surfaces in an airstream, and his paper is well worth reading even today. Prior to this time we had in this country a very great amateur of aeronautics, Sir George Cayley, the Father of British Aeronautics, who had made attempts twice at earlier stages to get together a Society of those who were interested in this new science, this very far-off science in those days.

Baden-Powell's address was not quite half-way in time between the date of formation of the Society and the present time. It was also only 11 months prior to the first powered fully controlled flight of a heavier-than-air aircraft. Baden-Powell referred to the work of the Wright Brothers, who at that time were known to have made very great progress in the art of gliding and to have obtained a mastery which was acknowledged on an international basis, but there was no hint in his address that such a spectacular flight as the one which was made at Kittyhawk on December 17th, 1903, would be so soon.

The primary purpose of my address on this the 90th anniversary of the founding of the Society, is to review our present position, to establish broad objectives for the future and to state some of the recent major policy decisions which the Council has taken. In the process of this review I hope to trace the evolutionary change in the relation between the Society and aeronautics over the years. In particular, to trace the evolution from an essentially amateur body of enthusiasts to the present stage when we see a powerful professional Society which is fully representative of aeronautics in this country and in the Commonwealth, and one which covers an extremely wide and growing range of scientific and engineering specializations.

Mr. Rowe went on to refer to points of similarity and of contrast between the Society's ideas now and those at the time of the first presidential address. There was no loss whatever, he said, of the vision and sense of pioneer activity: although horizons had widened immeasurably, the sense of having tremendous scope remained equally attractive now to bold and adventurous minds. The Society in 1903 could be considered as a sounding board attracting fundamental contributions (such as that of Bryan on aircraft stability), and contributions from close observers of the examples of flight in nature; but very little of a strictly theoretical type since most of those concerned were essentially practical men who wanted to make practical experiments.

The president continued: I referred earlier to the paper by Wenham. This was the first paper ever presented before the Society; it provoked a very good discussion on the general problems of heavier-than-air flight; it made an extremely penetrating attempt to explain where the forces for the support of the vehicle came from. A feature of the discussion was that it was animated, forthright, practical in the assessment of what was possible, and also scientific. There was no doubt about the enthusiasm of those who were our forebears in the early days of the Society. They had no data, little knowledge other than that acquired from their own observations, there was very little theory and their work was entirely speculative. There was no established aeronautical industry and there was nothing to reward them for their efforts except the great prospect of conquering the air. This prospect was assessed differently by different observers. A military man such as Baden-Powell thought of it as being a revolutionary means of obtaining a military advantage. Cayley, on the other hand, from the outset thought of the air as an ocean, in which it would be of the greatest advantage to civilization to move freely from place to place without let or hindrance of mountains or other barriers; and he had perhaps the greater vision of the best use of this new science.

The position of the Society in relation to the general public in 1903 was very little different from what it had been at its foundation in 1866; there had been some spectacular balloon ascents, there was enough interest to attract a crowd of 1,000 to go to a remote spot on the Sussex Downs for the Kite Flying Trials, but there was still no practical conviction that the conquest of the air was about to come. One senses that these practical men were

PROMOTING THAT SPECIES OF KNOWLEDGE . . .

feeling rather strongly in their ideas about the possibilities of flight, but everything was still very elementary. The public in the main was good humoured but really quite unconvinced and quite prepared to submit to ridicule the Balloonatics, as they were called, and even more so those who thought that a piece of structure could ever be made to remain aloft of its own volition.

The president next described the pioneers and the new class of members who had given added impetus to the activities of the Society at the beginning of the century; the beginnings of military aviation; and the recognized applications of aviation as a whole. He went on to refer to the list of past presidents and chairmen, mentioning Lt-Col. O'Gorman, Prof. L. Bairstow, Lt-Col. H. T. Tizard, Sir Sefton Brancker, Mr. C. R. Fairey, followed by "a succession of eminent scientists and engineers from industry and government service.

"The transition from the noble patron of arts and science to the more practical man of affairs and then to the professional man of science or industry is easy to mark, a transition from the speculative through the experimental to the practical and utilitarian in the science and art of aeronautics itself. The professional succession is clear from 1930; the advance in aeronautics in 65 years had been astonishing, but our Society was keeping pace in its activities, its organization and its leadership. A similar transition can be traced through the lectures, published papers and other activities of the Society."

Details of the expansion of the Society's activities, and its changes in organization, up to the present time were next given by Mr. Rowe. Summarizing progress since 1866, he listed the following phases of development and change that had occurred in the Society's affairs:—

The first phase we may call the Victorian, entered into with complete confidence in the ability of man to master the art and science of aeronautics as it had so brilliantly in so many other fields during the Victorian era. The Society essentially amateur, limited, one might almost say semi-private, but none the less attracting some of the most distinguished scientists of the day. This phase lasted for 30 years until 1896, when the Society had reached a very low ebb.

The second phase, the re-birth 1896-1910; a period of growing understanding of the fundamentals of flight, of practical experiment with kites, models, gliders, in free flight, and some work with artificial air currents. Such great names as Hargrave in Australia; Pilcher, Cody, Bryan, Lanchester in England; Langley, Chanute, the Wright Brothers in America; the Lilienthals and Prandtl in Germany; Ader, Farman and Blériot in France, appear in this phase. Many of them men of deep intuitive power who developed a "feeling" for the air which was to bear fruit later.

The third—the transitional—phase: 1910 to, say, 1923, during which we had the Great War, 1914-18, and the establishment of a new industry and a new science and art in aircraft design, construction and flying. This phase saw the clear emergence of the profession of aeronautics and of the Society as the representative body, although still without clearly defined professional standards. The Mond Chair of Aeronautics was established in Cambridge in 1919, and the Zaharoff Chair of the University of London in 1923.

The fourth phase, 1923-1948—growth and development to professional status. The most important phase in the Society's life so far. Strength in aeronautics finally became vital for survival; this Society and its members served their country with distinction during the Second World War; one remembers with pride the Royal Aeronautical Society Advisory Committee, set up by Lord Brabazon, which reported to him and successive Ministers of Aircraft Production on special problems needing professional judgment of the highest standards of integrity and competence, and the special conferences with the armed Services with complete trust in the Society and its staff in matters of security.

The present phase: Incorporation, 1949. . . . The great starting event of this phase is the Charter of Incorporation granted to the Society under letters patent by H.M. King George VI, our patron, on January 17th, 1949. This is a historic date; it established this Society as a Body Corporate and made our rights and responsibilities clear and manifest.

Mr. Rowe went on to enumerate the Society's basic rights and responsibilities. The general aim was expressed thus: "The objects and purposes for which the Society is hereby constituted are the general advancement of aeronautical art, science and engineering and more particularly for promoting that species of knowledge which distinguishes the profession of aeronautics." Concluding his address, the president said:

I have attempted to show you, however roughly, how this Society of ours has evolved to be a Chartered Professional Body Corporate; I have quoted from our Charter to illuminate our great responsibilities to our profession, responsibilities over a wide and growing field of art, science and engineering. The level of our work has been assessed by a great authority; it is no less clear from a consideration of the place, the prime place, of aeronautics in the national defence, and its great and rapidly growing contribution to transport and the development of the new resources lying untapped in the remote areas, almost unapproachable lacking air power and most certainly unworkable.

And what conclusion does one draw from all this? Speaking as one privileged and honoured to be your president for a brief twelve months, I think the conclusion is clear. Our Society must move forward; it must advance in such ways as will bring steadily increasing prestige and status to match, serve and adequately to represent the profession of aeronautics, which itself advances and widens in an almost breath-taking manner. We must have constantly before us the objective to become one of the major professional scientific and engineering bodies in this country and to advance our objective by all the means in our power. Nothing short of this is sufficient for the professional level of our work nor for the importance of aeronautics in the national interest. But this advance will not result from actions by the Council alone; it must be supported by a loyal and enthusiastic membership.

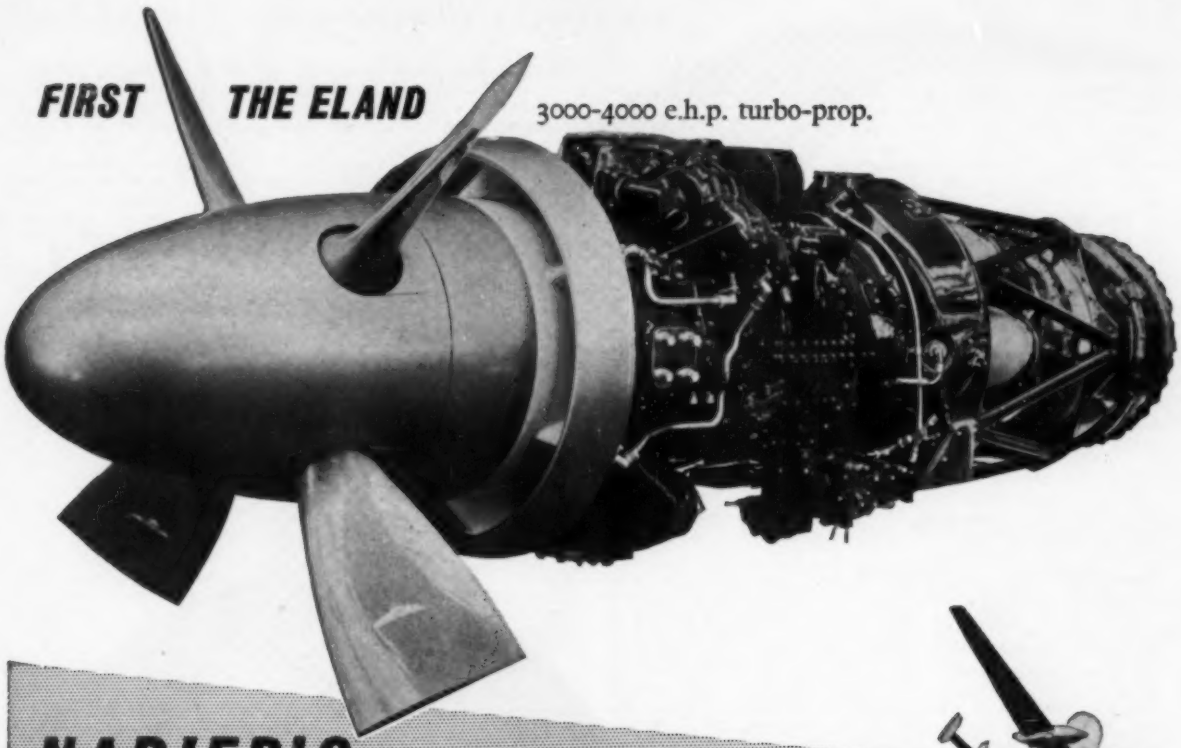
Such an advance must rest on many factors; first and foremost our professional gradings and, leading to these, educational standards readily recognizable and interpretable throughout the country. In particular we must have our own Higher National Certificate in aeronautics. For many years we have accepted the Higher National Certificate in mechanical engineering with endorsement for aeronautical subjects, but as a Chartered body this is no longer satisfactory. I mentioned earlier the higher standard for the Associate Fellowship examination introduced recently; this is a good level of scholastic attainment and will be retained, thus ensuring an adequate basic training for our professional gradings of Graduate and Associate Fellow. The Fellowship of the Society at present is awarded only to those who have attained a considerable degree of technical eminence in the profession of aeronautics. There has been expressed the view that this definition is in practice restricting the promotion of many who are fully qualified for the senior grading in a professional body. It is argued that the terms of the definition of the grade of Fellow imply that this grading is an honour in addition to a recognition of technical standing. I am glad to tell you that the Council has appointed a small but representative committee to examine this matter and action on their findings will be taken as soon as possible.

Secondly, if our Body Corporate is to be fully representative we must increase our membership. In fact, a drive for membership has already been initiated on the widest basis, and all are invited to help. The immediate aim is to double our membership during the next five years. Our strength in this country is only about a quarter of those available for membership now, so that our objective is very modest. It would, in my view, be to the advantage of aeronautics as a whole to have within one organization all those concerned with the technical aspects of the subject. We could readily assimilate as Sections, those bodies who now operate independently, we think to our mutual advantage.

Thirdly, we must have a home and lecture hall of our own. No. 4 Hamilton Place, which we owe to the foresight and wisdom of a small group of enthusiasts led by Sir Roy Fedden, ably backed by Laurence Pritchard, held on lease—where we have been so happily established since 1939—is rapidly reaching bursting point, and we must have increased accommodation fairly soon. But if we are to achieve that status and prestige necessary to discharge our responsibilities under the Charter, I am convinced that we must have our own place, even if it involves the step of acquiring a site and erecting a new building. We must take the large and long-sighted view in this matter and go forward with courage and with resolution.

Other matters need attention, for example, the lecture programme. I suggest we should now introduce commemorative (and endowed) lectures for the great ones of the past. Lanchester, Henry Royce, Bryan, spring to mind at once. In time these, each an honour to the lecturer and an occasion in itself, would form our main programme backed by section lectures, widened from the existing usage to cover the full range of aeronautical activities. In passing, I draw your notice to the great success of the "named" lectures run by the branches, the "Pierson Memorial" by Weybridge Branch (the initiators of this practice), the "Barnwell Memorial Lecture" by Bristol Branch, the "Sir George Cayley Memorial Lecture" by Brough Branch (follow-

FIRST THE ELAND 3000-4000 e.h.p. turbo-prop.



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THE ELAND The 3,000 e.h.p. Eland has reached the Type Test stage and a 4,000 e.h.p. version is now running. Another version, with an auxiliary compressor for the tip-powered rotor system, will be used in Fairey's large transport helicopter—the Rotodyne.
Apart from the accumulation of flying hours in a Varsity test bed, an Elizabethan has been converted for freighter evaluation trials. Soon a Convair 340 conversion will be demonstrated in Europe and North America.

THE ORYX Napier are working with Hunting Percival in the development of the Oryx 750-825 gas h.p. turbo-gas generator, a helicopter power unit which eliminates all mechanical transmission.

THE GAZELLE Mounted vertically in a new Bristol twin rotor helicopter, two Gazelles, directly connected to the rotor heads, represent mechanical transmission at its simplest.

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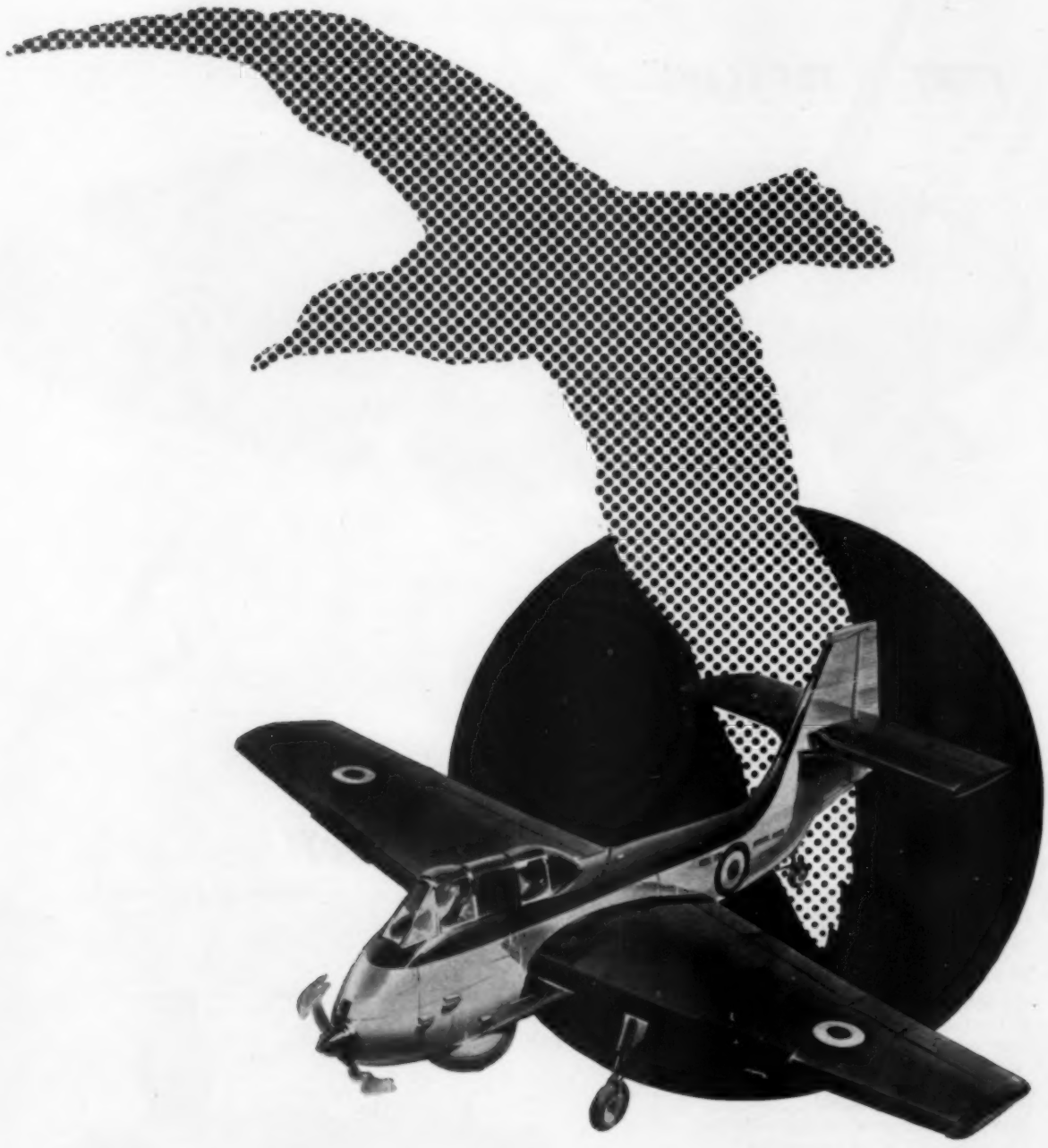

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PROMOTING THAT SPECIES OF KNOWLEDGE . . .

ing the suggestion of Robert Blackburn, lately deceased), the "Mitchell Memorial Lecture" by Southampton Branch.

In advancing the Society's professional standing we must not forget the wider responsibility for the "general advancement of aeronautical art, science and engineering"; the Society must be at one and the same time professional and representative of the art and practice not excluding activities which might still be classed as amateur. The Branches of the Society—which, while pursuing the same aims and objects, are autonomous and free to admit non-professional and lay members—are admirably suited to help in the discharge of this wider responsibility and their work is of the greatest value.

In this catalogue of "musts" I have left to the end the most fundamental point; in growing and developing let us ensure that we retain those high standards of professional integrity and disinterested care for the good of aeronautics and its further advancement, which have always distinguished this Society.

To sum up, our Society—an amateur foundation—has now reached maturity as a Chartered professional body. We recognize the challenge of our new responsibilities under the Charter of Incorporation and in relation to the primary place now occupied by aeronautics in defence, transport and the exploitation of new untapped resources. I have suggested a number of objectives, some broad and others more detailed. It appears to me that time measured by human standards shortens with increasing age. From the point reached by myself, ten years seems not very long. Let us see to it then that by 1966, our Centenary year, we shall have acquired the stature appropriate to the work of this Society. Let us go forward with enthusiasm and resolution for the good of aeronautics and all that depends upon it and for peace. And to give point to this I am authorized by the Council to launch here and now a Centenary Fund to be devoted to the acquisition of a fitting house for the Society to come into use by January 12th, 1966.

A final word. Our Society is entering another phase in its development, which will carry it forward to a new leadership arising from new and greater responsibilities. Whether we like it or not, we must pioneer the way in even more difficult fields of pure and applied science. As in the past, but in greater degree, our work will set the pace and give the lead over a widening range of science and art. Let this be the inspiring background to our service to aeronautics and to our membership of this Society, which has given so great a heritage and offers so rich a field for our continued loyalties.

"WORK STUDY" IN HELICOPTER MANUFACTURE

IN contrast to the more usual type of subject, a paper dealing with the principles of work study was read at the fifth meeting of the Helicopter Association's 1955-56 lecture session, held in the library of the Royal Aeronautical Society on January 6th. Entitled *Economic Production of Helicopters—Some Future Possibilities*, the paper was presented by Mr. L. J. Harper, Head of the Work Study School, College of Aeronautics, Cranfield. Dr. G. S. Hislop was in the chair.

Speaking in general terms, Mr. Harper said that work-study techniques, to improve productivity, could be applied to the helicopter industry as well as to any other. Productivity, the measure of an industry's well-being, was defined as the ratio of output to input. Output was the end-product and its associated services, while input was represented by capital resources and equipment, materials and labour.

When, as in the helicopter industry, output was restricted by the high cost of the product or by limited market requirements, the only way of increasing productivity was by making economies in input factors. The lecturer quoted a number of examples showing this had been done in other engineering industries and explained how the principles could be adapted to suit any individual requirements. He said that work-study was just beginning to be accepted in the aircraft industry generally and a number of his students had achieved remarkable results in various aircraft constructing companies. Work-study methods could be applied with advantage equally to design and administration procedures as well as to the actual manufacturing processes; and, to enable the investigations to be carried out properly, the specialist work-study officer should be afforded a sufficiently high status in a company. He should be able to talk on equal terms with at least second-line management.

Among the contributors to an edifying discussion which followed the lecture was Mr. D. D. G. Franklin, production planning engineer, Westland Aircraft, who said that his company had recently introduced a form of work-study into their organization and were achieving excellent results. In the manufacture of certain rotor-blade components, the new techniques evolved had already allowed a saving of 27 per cent of cost to be made.

MONDAY-MORNING SCENE: A WHITE APRON AT L.A.P.

The morning of Monday, January 9th, found the new buildings and apron at London Airport Central transformed by a heavy snowfall. As this view of the apron suggests, the day's first task was to remove snow from the wings and fuselages of parked aircraft—a process which delayed departures by up to one hour. At top right, incidentally, a new type of tail marking is discernible on one of the five B.E.A. Viscounts seen in the photograph; the sixth (left) belongs to Aer Lingus.

GERMANY TODAY

—as Seen by a British Aeronautical Engineer

SIR ROY FEDDEN

READERS of last week's issue will have seen our abstracts from Sir Roy Fedden's paper given at the Aircraft Production Conference, in which he made some forthright criticisms of the British aircraft industry. The lecture contained brief references to the aircraft industries of Germany and Russia; in the present article, which is exclusive to "Flight," the author enlarges on these subjects. Sir Roy Fedden, M.B.E., D.Sc., Hon. F.R.Ae.S., M.I.Mech.E., F.R.S.A., M.I.A.S., M.S.A.E., has had a long and distinguished career in aircraft engineering, notably in the field of engine design and production.

SOON after the war, Sir Stafford Cripps sent me to Germany with a team of engineers, in two Dakota aircraft carrying two Jeeps, to find out all we could about German jet engines and the new aircraft into which they were fitted. Our report said we were profoundly impressed by what we discovered and that there was aeronautical research going on at the cessation of hostilities with which there was nothing to compare in the U.K. or U.S. Had the war continued another 18 months the story in the air might have been a different one.

We flew back from time to time with special examples, and eventually there was set up in my offices at Cook's building, in Stratton Street, a comprehensive exhibition of advanced German technique. At the time many serving officers and technicians came and looked at this exhibit, but we who had spent many weeks assembling it were amazed at the comments, which, broadly, were: "most interesting," "rather fantastic," "why worry, haven't we won the war?" Subsequent events, over the last ten years, go to prove that it was unfortunate that such available data were not taken more seriously; and there is little doubt our American Allies and the U.S.S.R. benefited greatly by appreciating its true value.

I had not had occasion to return to Germany until last autumn, when I spent most of October on an engineering fact-finding tour, during which I motored about 3,000 miles and went over a good deal of the ground which I had surveyed with my team in 1945. I attended the conference of the German Scientific Institute for Aviation at Augsburg, at which there were 650 delegates, including many nationalities. Great enthusiasm was shown and many plans discussed for the future.

It was interesting to meet the leaders of the past German aircraft industry again, and to hear what they had been doing during the last ten years, and their plans for the future. I visited plants connected with aircraft and engines in pre-war days, and heard that gradually they were collecting together their old staff and, while working on bread-and-butter products, considering new lines to embark upon for the future. Obviously, any come-back in aviation will be a much longer-term affair than in 1933; but I realized that the urge and determination was there.

I was impressed with the remarkable recovery that Germany has made since 1949, and duly noted the keenness of management and workpeople, and the strides that have been made with limited facilities and improvization. One can clearly see the mark of adversity on both executives and workpeople. Since the war they have had such hard times that they are enthusiastic about solid employment. How long this will last it would be difficult to say, but the competition that we may expect from many outstanding firms with their newly set up plants will indeed prove to be a testing time for our engineering fraternity. A 48-hour week is standard for the workpeople; offices start at 8 a.m. There are no tea breaks or other diversions.

In my report of 1945 I said that certain towns had been so badly bombed that I doubted if they should be rebuilt, and that it might be better to start again afresh. In this I was wrong; but the reconstruction work that has been done is astounding, although it is incorrect to say that Germany is rebuilt. Ten years after the war one is shocked at the acres and acres of bombed sites still existing, which are more extensive and far worse than anything in this country. The philosophy has been that it is no good building houses before factories, public buildings, etc. It is only during the last 18 months, therefore, that there has been any serious reconstruction of private dwellings.

The Germans' approach to their problem is striking when we realize what has been done in our own country and what is still left undone, and it may be that a *via media* might have been a better policy to take in this country. The design and construction of some of their rebuilt railway stations and bridges is outstanding, and brings home the vision and boldness of their civil engineering. There is no question at all that the German people, from top to bottom, are working very hard indeed, and it is disturbing to see this in comparison with what is all too prevalent in this country today. It is also distressing to have brought home to one so emphatically how we have thrown away our chances in the last ten years.

One of the most topical subjects I was able to look into was technical education, and I had the opportunity to talk to several German education authorities on this all-important question. I also discussed this matter with a number of senior German aeronautical technicians who had spent anything up to nine years in Russia. They speak highly of Russian education, the importance and devotion that is given to this whole matter, and the urge there is to become an aircraft engineer. I am told on good authority that there are 6,000,000 permanent resident students in Russian universities, and that last year over 100,000 of these graduated in engineering. There is none of the stigma that is attached to engineering as a profession that there is in this country. On the contrary, the "red carpet" is put out by the family for the son who chooses some branch of engineering and successfully qualifies.

The following table gives an overall picture of how the training of engineers is being tackled in the four most important countries. If this country is expected to survive at all as a great power, the figures make sombre reading.

ANNUAL OUTPUT OF ENGINEERING GRADUATES (1954)

Country	Full-time students (all faculties)	Period for graduation (engineering)	Number graduating (engineering)	Number from part-time courses (engineering)
G.B.	80,602	3	2,237	6,923
U.S.A.	2,500,000	4	22,329	—
U.S.S.R.	6,000,000	3	102,000	50,000
Germany	121,000	4½	3,000	6,000

With technician friends and acquaintances who have spent a long time in Russia I had interesting talks on the progress of Russian aviation. As a result of these discussions I have arrived at the conclusion, which is purely a personal one, that German technical opinion of Russian aviation is divided into two camps: those who think that everything that U.S.S.R. are doing in aviation is excellent and better than anything else, and those who are derogatory to their technique generally.

From questions I was able to put in regard to Russian research equipment, machine tools, design teams, etc., I formed the opinion that probably the right answer lies between the two. I do not believe that Russia is outstanding in basic thinking. They have had enormous benefits from a big group of German technicians whom they have sucked dry and have now, with a few exceptions, returned to their native land. The Russians' planning has been good and realistic, their timing excellent. They have made a point of concentrating on a very few aircraft types and building them in large quantity. Probably their best fighter, attributed to a Russian, owes much to German technicians.

In Russia the greatest prestige is given to creative work. Consequently, such professions as those of artists, musicians, ballet dancers, highest-grade teachers and aircraft engineers receive greater honour and more money than others. A senior aircraft engineer is responsible for signing a contract to produce a design to a certain specification and date. If he failed to accomplish this and it could be proved a serious mistake had been made he might be stripped of his honours and salary and, in extreme cases, would go to prison.

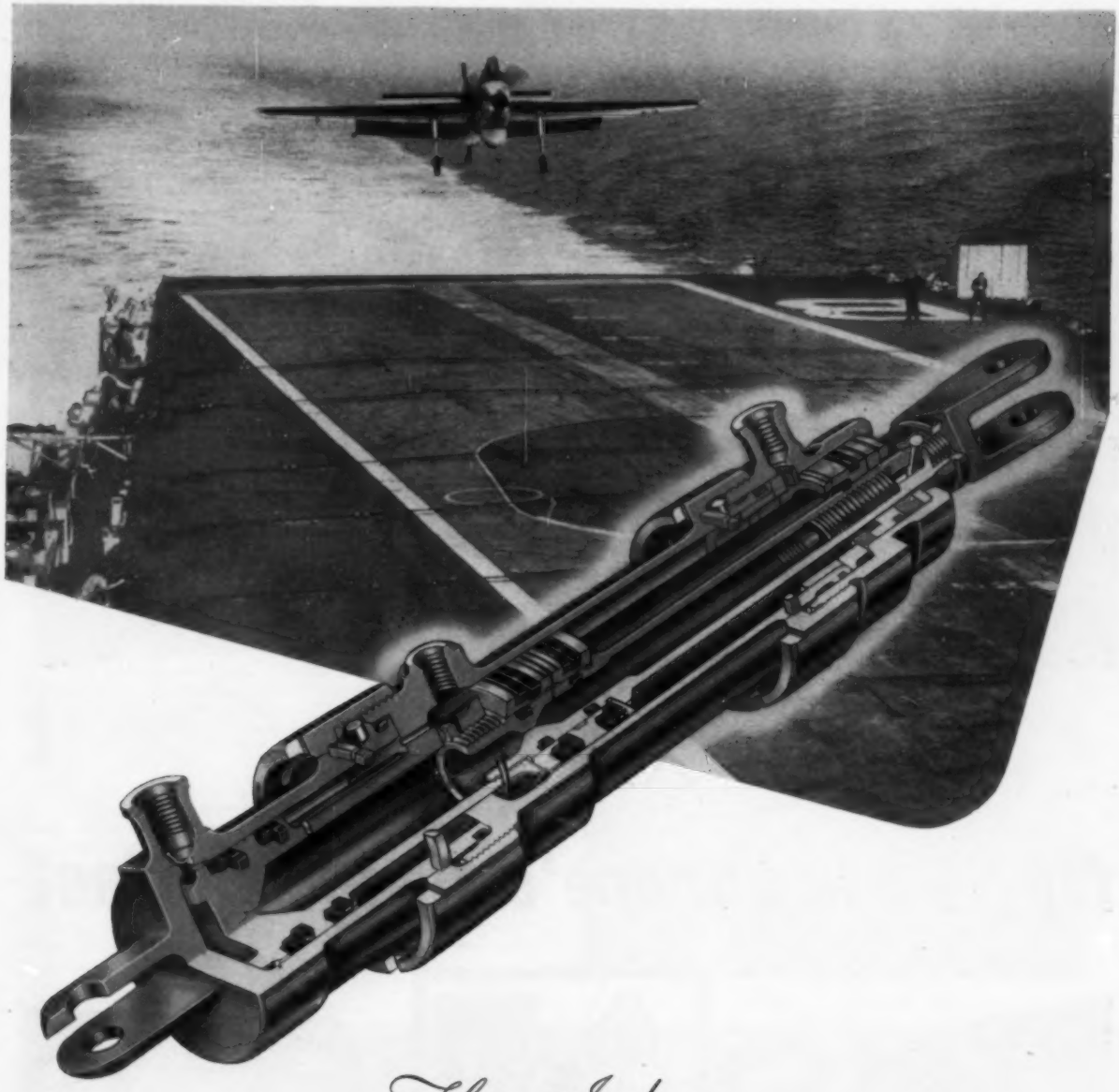
With the acceptance of Germany into NATO it would seem a suitable time to confer with her on such questions as technical education, research into engineering materials, inspection methods, etc.; but we must send over people of high enough level, in order to command respect and interest.

AIR-MAPPING PERSIA

MORE details are now available of the contract, worth some £250,000, awarded by the Persian Government to the Air Survey Co., Ltd. One of the biggest air survey contracts ever awarded to a British firm, it was gained in open international competition.

The work will include not only topographical mapping but surveys for town planning, road, rail and pipe-line construction, irrigation, hydro-electric schemes, ports and aerodromes, and geological exploration.

The contract appoints the Air Survey Co. (which is a subsidiary of the Fairey Aviation Co., Ltd.) as consultants and contractors to the Persian Government and also requires the company to instruct Persian technicians, during the next two years, in aerial photography and the preparation of maps.



Flap Jack

A variety of hydraulic jacks is required for modern aircraft, the construction of each jack being "tailored" to fit its particular function. The flap jack shown is a three-position unit permitting definite stages of extension to be selected. This jack is but one of over 40 different types of British Messier 4,000 p.s.i. hydraulic units fitted to the Short Seamew.

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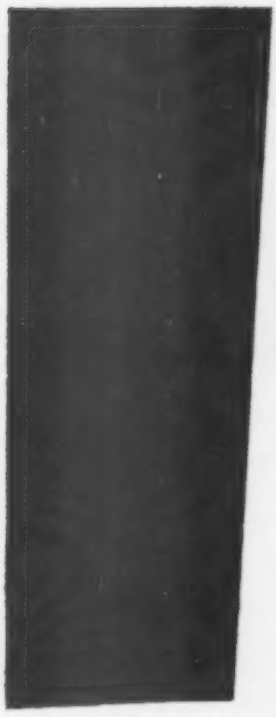

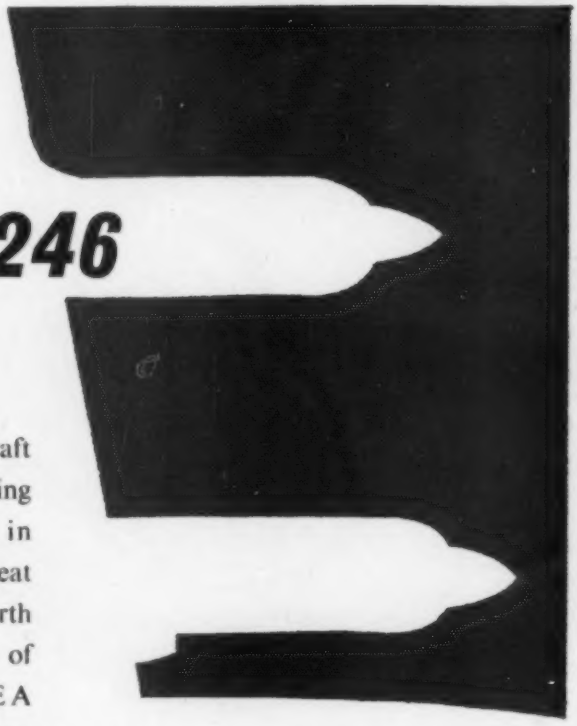

25,389,246 miles

were flown by BEA aircraft during the year ending October 31st, 1955, in serving 67 airports in Great Britain, Europe and North Africa. In the course of these operations BEA carried 2,128,617 passengers—330,013 more than in the previous year.

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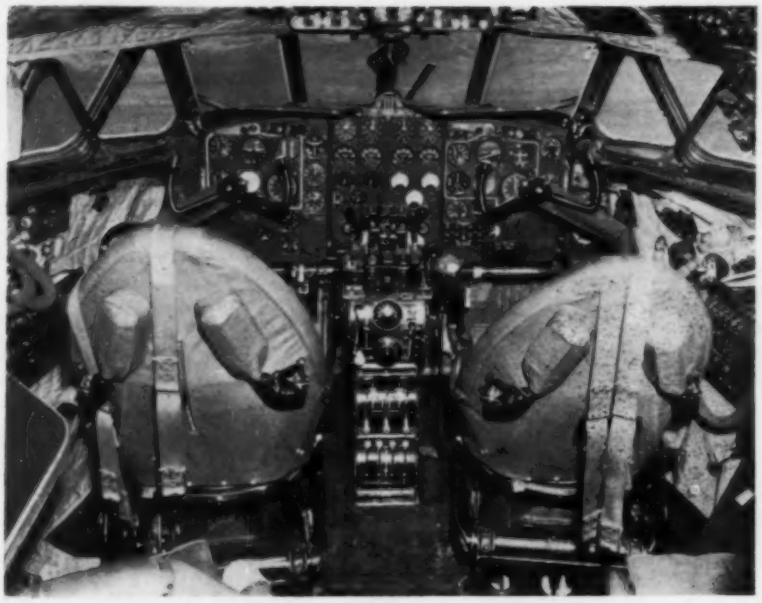
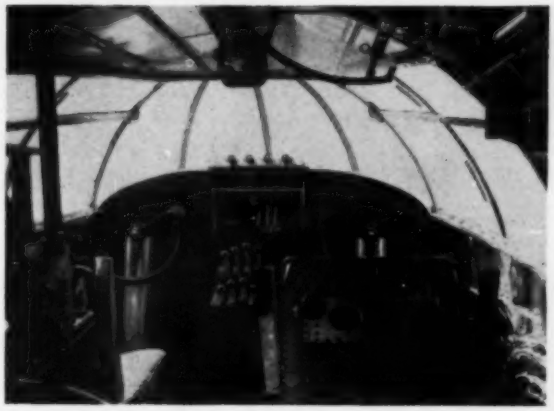
BRITISH EUROPEAN AIRWAYS



FLIGHT DECKS 1936–1956

AIRLINE pilots reared on the present generation of multi-engined aircraft will regard the cockpit shown in the right-hand photograph as a strangely empty place. Yet the aircraft—a Short Empire flying boat of 1936—was in its day one of the world's foremost trunk-route transports. When the photograph appeared in *Flight*, 20 years ago, we commented that the control cabin boasted "probably more instruments . . . than in any other civil machine in this country."

With the advent of retractable, steerable undercarriages, reversible airscrews, a multiplicity of radio aids, new instrument systems and pressurization, flight-deck layouts have grown steadily more complex. Today, however, there are signs that the pendulum is beginning to swing the other way. It is reassuring to note that the control cabins of the Comet (top) and Britannia (below) are no more complex than those of their immediate predecessors. Indeed, in some respects —notably engine-handling—pilots of the new generation of airliners require fewer controls and instruments.



(Top) Pilots' stations in the prototype de Havilland Comet 3; the Comet 4 will have an essentially similar layout. Provision is made for a maximum operating crew of five.

(Centre) An "office" familiar to more than one of B.O.A.C.'s senior captains: the spacious flight deck of the 1936 Short Empire boat.

(Right) This view of the captain's and first officer's stations in a B.O.A.C. Britannia 100 hints at the great width of the cabin. There are five crew positions, but the aircraft is A.R.B.-approved for operation by a crew of two.

FLEET REGISTER

A Supplementary List of U.S. West Coast Airliners in Service or on Order

DETAILS were given in last week's issue of *Flight* (page 61) of orders placed for the newer types of transport aircraft. To complete the picture, we now present a register of the best-selling American piston-engined airliners not included in last week's table. Our object has been to show present ownership or ordering of the types concerned, rather than to compile a list of original orders; such a list would not have taken into account the effects of accidents, airline mergers and sale or exchange of aircraft. Production of the Models 240 and 340 Convair-liner is now at an end, and Convair's San Diego factory is now completing the first of a new series—the Model 440 Metropolitan. As reported last week, orders had then been placed for a total of 65 CV-440s. In addition to the airliner-operated Convair 240 and 340s listed below, at least 20 have been delivered to "corporate" owners and a further 40 to the U.S. Navy and Air Force. This latter figure does not include about 300 military versions delivered under the designations T-29, C-131B and R4Y. At the end of 1954 Convair had completed a total of 715 aircraft of 240/340 basic type, nearly half of them to military order. Orders for 104 DC-7Cs, tabulated in last week's issue, bring the total number of DC-6/7-series *civil* aircraft sold by Douglas to at least 780. In addition, the U.S. Forces have bought more than 220 military variants, the majority based on the DC-6A. Both the DC-6A and '6B are still in production; some of those listed below have not yet been delivered, and the list of operators may not include all the new customers for these types. The Constellation table lists those of the 202 sold which are known to be still in airline service. Of the Super Constellations listed, a number of L.1049Gs and all the L.1049Hs have yet to be delivered. Not included in these tables are some 250 military Constellations and Super Constellations bought by the U.S. Forces. Other American transport aircraft sold in large numbers are the Boeing 377 (56 Stratocruisers and over 700 military C-97 variants sold) and the Martin 2-0-2/4-0-4 series, which received little military support; a total of 146 were sold, however, to commercial operators.

CONVAIR-LINER MODELS 240 AND 340

Operator	Type	
	240	340
Aerolineas Argentinas	4	
Aeronaves de Mexico		4
Aerovias Venezolanas		5
Alitalia		4
American Airlines	75	
Ansett Airways		2
Braniff Airways		16
Canadian Pacific Airlines	5	
Continental Air Lines	5	14
Delta-C. & S. Air Lines		20
Compania Mexicana de Aviacion		8
Ethiopian Air Lines	2	
Finnair		3
Garuda Indonesian Airways	8	8
Hawaiian Airlines		5
J.A.T. (Jugoslavia)		3
K.L.M.	7	14
LACSA (Costa Rica)		2
L.A.I.	5	
Lufthansa		4
Mohawk Airlines	3	
National Airlines		12
Northeast Airlines	6	
Orient Airways	3	
P.A.A.	5	
Philippine Airlines		3
Real (Brazil)		8
Sabena	5	
Saudi Arabian Airlines		4
Servicos Aereos Cruzeiro do Sul		4
Swissair	7	
T.A.A.	5	
United Air Lines		55
VARIG (Brazil)	5	
Western Air Lin	9	

LOCKHEED L.1049 SUPER CONSTELLATION

Operator	Type					
	1049	-C	-D	-E	-G	-H
Air France		9			14	
Air-India International		2		3	3	
Avianca		3			4	
Compania Cubana de Aviacion		1			2	
Eastern Air Lines	14	16			10	
Flying Tiger Line						10
Iberia		3			2	
K.L.M.		12			4	
L.A.V. (Venezuela)				2	1	
Lufthansa					8	
Northwest Airlines					6	
Pakistan International		3				
Qantas		10			2	2
Seaboard and Western			4			5
Slick Airways						5
T.A.P. (Portugal)					3	
T.C.A.		7			2	
T.W.A.	10			10	28	
U.S. Overseas Air Lines						2
Varig (Brazil)					3	

LOCKHEED L.649/749 CONSTELLATION

Operator	Type	
	L.649	L.649/749
Aerovias Guest (Mexico)		2
Air France		20
Air-India International		3
Avianca (Colombia)		
B.O.A.C.		16
Capital Airlines	12	
Compania Cubana de Aviacion	2	
Eastern Air Lines		19
El Al	4	
K.L.M.		10
L.A.V. (Venezuela)		2
South African Airways		4
T.W.A.	32	39

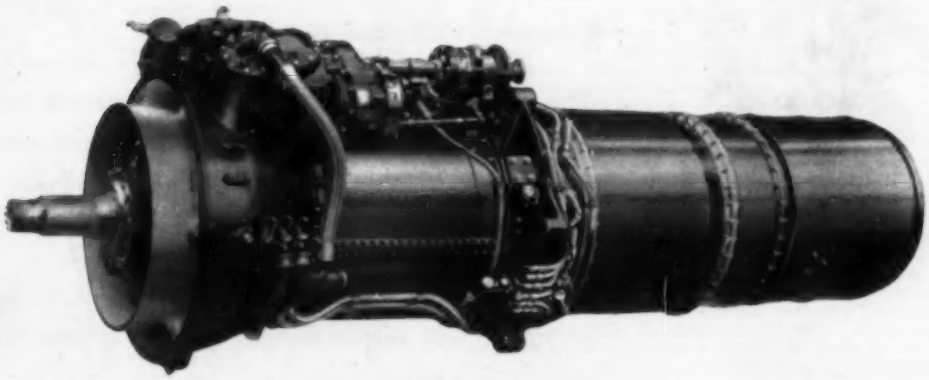
DOUGLAS DC-6 SERIES

Operator	Type		
	DC-6	DC-6A	DC-6B
Aerolineas Argentinas	6		
Alitalia			4
American Airlines	50	3	25
Aramco			2
A.N.A.	2		2
Braniff Airways	9		
Canadian Pacific Airlines			4
Cathay Pacific Airways	1		
C.M.A. (Mexico)	4		3
Continental Air Lines			10
Delta-C. and S.	7		
Flying Tiger Line		7	
Japan Air Lines			6
K.L.M.	6	1	7
L.A.I.	3		2
L.A.N. (Chile)			3
National Airlines	4		8
North American Airlines			2
Northwest Airlines			15
P.A.A.		3	45
Panagra	4		4
Sabena	4	2	8
S.A.S.	12		14
Slick Airways		3	
Swissair			6
T.A.I. (France)			5
T.E.A.L.	3		
U.A.T. (France)	7		
United Air Lines	42	5	42
Western Air Lines			8

DOUGLAS DC-7 AND DC-7B

Operator	Type	
	DC-7	DC-7B
American Airlines	39	
Continental Air Lines		5
Delta-C. and S.	17	
Eastern Air Lines		40
National Air Lines	4	
P.A.A.		7
Panagra	5	
South African Airways		3
United Air Lines	42	

The Short Seamew light anti-submarine and maritime reconnaissance aircraft in production for the Royal Navy and the Royal Air Force is powered by a single Armstrong Siddeley Mamba turboprop. The light weight and small dimensions of this engine have enabled it to be installed under the flooring of the pilot's cockpit so that the entire crew, together with the radar equipment, are all located in the nose of the machine where they can operate to the best advantage.



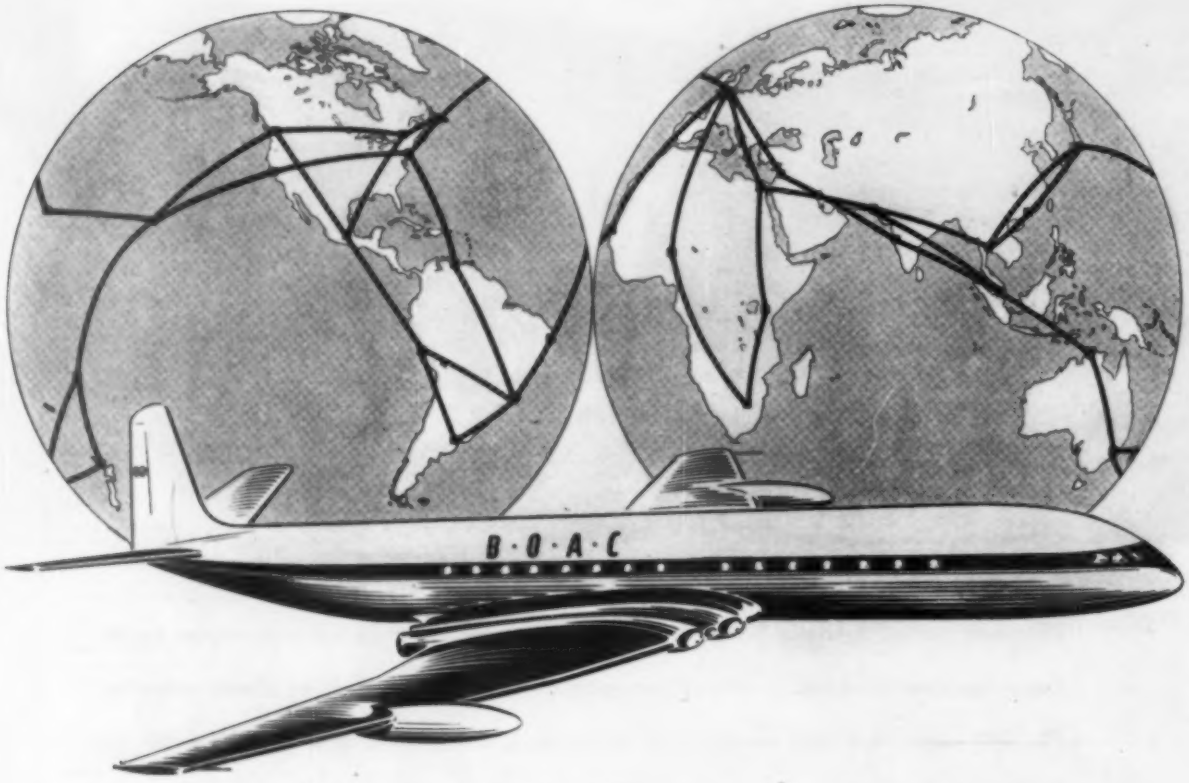
ARMSTRONG SIDDELEY AERO ENGINES

ARMSTRONG SIDDELEY, COVENTRY & BROCKWORTH

Members of the Hawker Siddeley Group

Anywhere on earth in 36 hours

by COMET



The new Comet, carrying 60 first-class passengers on 3,000-mile stages, is of ideal size for linking the world's many traffic centres. It makes possible high frequency with profit-earning loads.

The new Comet embodies all the experience gained in six years of pioneering jet airliner development. Behind it are 30,000 hours of airline service and half a million hours of operating experience with Rolls-Royce Avon engines.

B.O.A.C. will introduce the Comet 4 into world service in 1959.

DE HAVILLAND of GREAT BRITAIN

FOUR KINDS OF APPROACH

A Comparison of the Four Flight-director Systems now being Offered to the Airlines

IT is rarely that a small number of keen competitors gather under one roof to describe their products to potential customers. Such a meeting could easily be a mere exposition of salesmanship, with the withholding of information that might be of value to the opposition. Nothing of the kind was apparent at the meeting on January 10th at the Grosvenor Hotel, London, where some 40 airline pilots from 20 countries attended an all-day meeting of I.F.A.L.P.A., the International Federation of Air Line Pilots Associations.

It had been thought opportune to convene, in the same point of space and time, the four principal makers of flight-director systems—Bendix (U.S.), Collins (U.S.), Smiths (U.K.) and Sperry (U.S. and U.K.) for the enlightenment of future users of this equipment. Each maker's representative—Mr. R. L. Vickers for Bendix, Mr. G. Ewbanks for Collins, Capt. A. M. A. Majendie for Smiths, Mr. C. A. Richardson for Sperrys—described his own system, its method of operation and its underlying philosophy clearly and succinctly, and responded generously to the discussion that followed. We use the word "clearly" in its relative sense, since an average member of the public would have been quite unable to follow the discourse: even pilots whose instrument ratings lapsed only a few years ago would have found it difficult to hold a steady course.

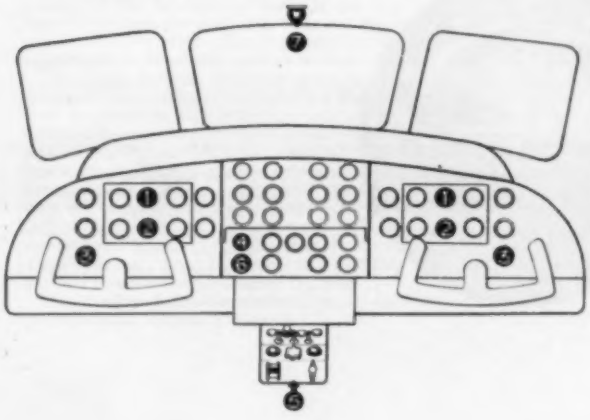
Before we describe each system, it is appropriate to recall how flight-director systems have come about, and also to relate some of the points brought up in the discussion.

The position has been reached today where the pressure on instrument-panel space in an airliner cockpit has become so great, and the pilot so overburdened, that means have been sought to interpret information from ground radio aids as simply and collectively as possible, yet without radical departure from accepted techniques. The illustration below shows the simplification—a typical one—achieved by the Smiths system. Flight direction achieves a very high degree of accuracy in navigation and in the approach, a necessary requirement for the full exploitation of turbine airliners, whose economy suffers heavily from inefficient operation, particularly in the matter of traffic control procedure.

Smiths Flight System instrumentation, shown diagrammatically.

1 Director horizon (two).
2 Beam compass (two).
3 Compass annunciator unit (two).
4 Main selector.
5 S.E.P.2 central controller.
6 Engage and trim indicator.
7 E2A stand-by magnetic compass.

Eight of the items enumerated above are panel-mounted instruments (all 3¼in except 4, which is 2¼in), and they perform or replace the 17 functions of the following: two artificial horizons; two gyro-magnetic compasses; two flight directors; two I.L.S. meters; two autopilot heading selectors; one coupling selector for autopilot; one coupling selector for flight director; one autopilot engage and trim indicator; two annunciator units (control panels for each half of the twin compass).



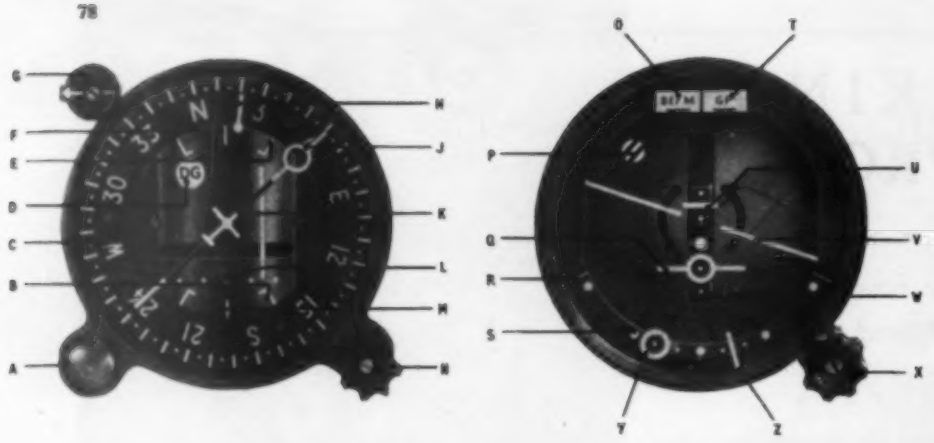
Appropriate to the accompanying article on flight-director systems is this recent picture of the new approach lighting at Idlewild Airport, New York. The lighting consists of 20 Strobeacon units in a 2,000ft row, each unit having a high-intensity xenon flash-tube producing a 30m candle-power beam flashing twice every second in a sequence which gives the effect of an "animated arrow" pointing at the runway.

The aim of every flight-director system is to provide the pilot with a clear and easily understood picture of the aircraft's situation in such a way that he knows what to do at every instant without having to judge whether the quantity he is trying to control is changing as it should. In the approach he is given precise steering information, and is directed to fly right or left, up or down. At every moment he is informed whether he has taken, and is *continuing to take*, the correct action. For *en route* navigation, the system provides information that will put the aircraft smoothly on to a selected course. Heading and position information are combined with steering guidance to help the pilot hold his selected course accurately.

Emphasis at the I.F.A.L.P.A. meeting was placed particularly on the approach problem, and this was the main topic of the discussion. A point about the "sense" of instrument presentation was raised. There is still a surprising divergence of opinion as to whether "the outside world" should be shown as remaining steady while the index is flown on to it, or *vice versa*. It was remarked that tests on a number of pilots had tended to show that the most natural reaction was to the latter form of presentation, and that a needle moving away from the control was not naturally easy to follow. Yet, as was pointed out, identifying oneself with the needle and flying on to a "fixed outside world" was admirable until the moment of transition to visual arrived, when a quick mental adjustment had to be made. It was suggested that if the instrument were shaped like a miniature windscreen no argument would ever have arisen. The different views were perhaps best summed up by one pilot who said he was not certain which system was the better—his main difficulty lay in getting the two together either way! Concerning the size of instruments, i.e., 3in or 5in, it was pointed out that, although pilots usually preferred the larger size for direction instruments, aircraft and instrument manufacturers generally liked to standardize on the smaller.

Smiths Flight System. The Smith system was described in some detail in our issue of August 19th, 1955, but it is appropriate in this comparison of the four flight directors to recapitulate its basic features. As the diagram at the foot of this page shows, the functions of 17 flight instruments are performed by eight. The two main instruments are the director horizon and the beam compass, as illustrated on the next page.

The system is composed of an S.E.P.2 automatic pilot, a twin compass system (including two beam compass indicators, as illustrated), a twin gyro vertical and comparator unit, two director horizon indicators (as illustrated), a primary control selector, and a stand-by magnetic compass. The combined installation provides the following facilities: (1) duplicated indication of aircraft attitude in a manner similar to that of normal artificial horizons; (2) duplicated indication of magnetic heading from two independent gyro-magnetic compasses; (3) repeated magnetic heading information for other equipment e.g. R.M.I.; (4) duplicated presentation of I.L.S. and V.O.R. displacement



The primary instruments of the Smiths system: the beam compass (left) and director horizon.

FOUR KINDS OF APPROACH . . .

information related to the heading of the aircraft to give a complete plan picture; (5) duplicated flight-director control by attitude demand signals for bank and pitch superimposed on the artificial horizon; (6) facilities when linked with the S.E.P.2 autopilot for course steering, turns on to pre-selected headings, maintenance of pre-set pressure altitude, airspeed monitoring, V.O.R. tracking, and fully automatic I.L.S. approach; (7) duplicated course-selection common to both autopilot and flight director on primary compass indicators; (8) common function-selection for radio coupling in both autopilot and flight director, including selection of port or starboard compass system for heading control; (9) single-knob control of all normal manœuvres for both flight director and autopilot; (10) simple magnetic compass as standby.

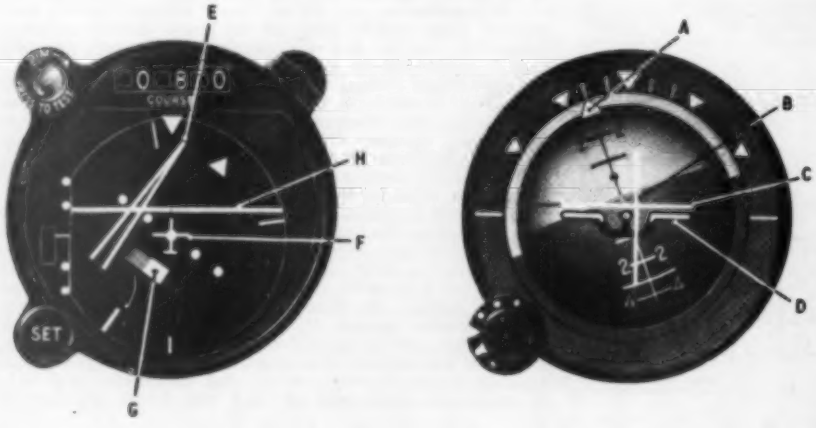
The two principal units of the system are the S.E.P.2 autopilot and the twin compasses. The autopilot uses magnetic amplifiers and provides radio coupling, approach coupling and height and airspeed monitoring. The twin gyro-magnetic compasses cross-monitor each other and an important safety feature is that warning is given should the readings differ by more than five degrees. The director horizon, illustrated above, provides attitude indication combined with steering and pitch commands derived from the beam compass for following I.L.S. or V.O.R. Lateral attitude is shown by the horizon bar and bank ring-sight pointer—as in an artificial horizon. Pitch attitude is indicated by the relative position of the horizon bar and the pitch pointer, or miniature aeroplane. Commands are given by the pitch-director pointer, which indicates where the pilot should put the miniature aeroplane to follow the glide path, and (also) by the azimuth-director pointer which tells him which way he should bank to line up with the localizer, on final approach, or V.O.R. if *en route*. In the illustration the pilot is being directed to pull up the nose and alter course to starboard.

The beam compass shows the aircraft's heading relative to selected I.L.S. or V.O.R. indicated by the pointer on the compass scale; the setting knob rotates the scale to bring the selected heading up to the proper position. Setting the heading index on to the selected heading ensures that the director horizon will give instructions for turning on to that heading, which may be a V.O.R. radial or an I.L.S. localizer. The vertical radio displacement bar indicates where the selected beam lies in relation to the aircraft; its associated horizontal scale provides a measure of distance. Scales at the bottom and top of the instrument indicate the sectors in which the system locks on to follow a beam or radial, as selected by the sense knob at top left. Drift due to cross-wind can be compensated for when on I.L.S. approach by suitably offsetting the heading index.

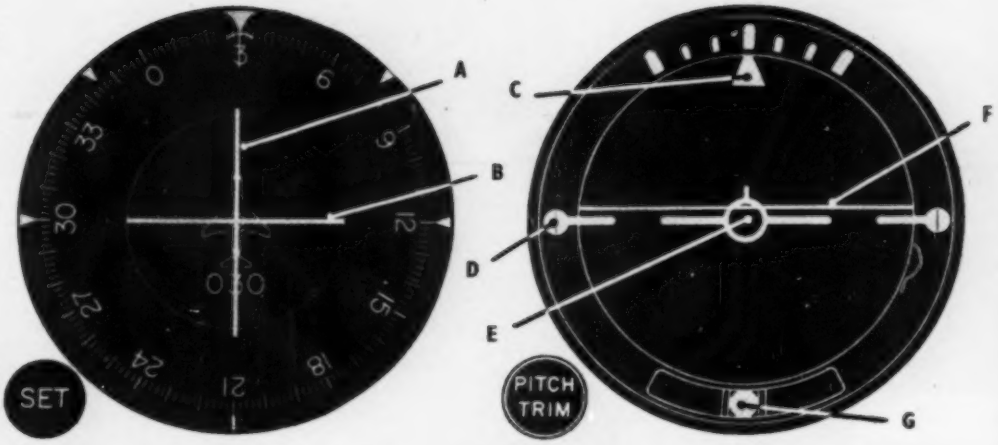
Sperry Integrated Instrument System.—This system comprises three principal instruments which form a half of the "basic six" group of the standard instrument panel as established in 1953 by the Society of Automotive Engineers. These are: horizon director (Model HZ-1), deviation indicator (Model R-1), and Gyrosyn compass (RMI, Model C-6). The last-named instrument is not included in the illustration below.

The horizon flight-director, as illustrated, has horizon presentation of the "barless" type. It retains the well-known features of the Zero Reader and is in effect a combination of the flight director and the gyro horizon. Two conventional flight-director pointers stand out clearly on the background of two-tone grey. The horizon moves with "the outside world" natural horizon; thus the pilot, while flying on the flight-director pointers, is aware of his pitch-and-roll displacement without reference to another instrument. The horizon presentation is provided with a pitch scale with 10-deg graduations from level flight up to 90 deg. A climb-and-descent knob permits setting of the "up and down" pointer to read zero for climbs and descents; this pointer is a sensitive indication of pitch, giving half-scale deflections for only 7½ deg of pitch. The instrument is servo driven and operated from a remote, non-tumbling vertical gyro. Flags are provided to indicate failure in any part of the system.

The pictorial deviation indicator, as illustrated, provides indication of glide-path displacement and V.O.R. displacement. Omni-bearing selection is incorporated, and as the aircraft heading changes from this setting the meter rotates accordingly to show pictorially the angular position of the beam. The V.O.R. pointer is a narrow "V": when the aircraft is flying *to* the V.O.R. station this "V" points to the top of the instrument. As the aircraft passes into the *from* zone a quick reversal of sense clearly indicates to the


A Horizon displacement.
B and C Flight director pointers.
D Pitch bar.
E V.O.R. pointer.
F Miniature aircraft.
G Three-position (Off, V.O.R., I.L.S.) flag.
H Glide path displacement.

The horizon flight director and deviation indicator of the Sperry system (the R.M.I. Gyrosyn compass is not illustrated).



A Heading pointer.
B Glide slope pointer.
C Horizon displacement.
D Pitch-and-roll indices.
E Miniature aircraft.
F Horizon bar.
G Slip indicator.

The two instruments of the Bendix system are the flight-path indicator (left) and flight-director indicator. These are both 4in-diameter instruments (the R.M.I. compass is now shown).

pilot that he has passed the V.O.R. station, in the manner of an ordinary A.D.F. indicator. A glide-path deviation pointer is visible except when the radio is tuned to an I.L.S. frequency.

No compass graduations are incorporated, since they are provided on the R.M.I. Gyrosyn compass (not illustrated). This instrument has a rotating dial and two radio pointers driven from either A.D.F. or V.O.R. as selected from an integrally mounted switch. Setting the course marker provided on the compass card simultaneously sets the heading for the horizon flight-director, eliminating the need for a separate heading selector.

The Sperry system may be installed in aircraft not equipped with an automatic pilot, or it may be combined with the Sperry A-12 Gyropilot.

Bendix Flight Director.—The Bendix flight director system, as developed by the Eclipse-Pioneer Division of the company, comprises two instruments, as illustrated; these are the Flight-path indicator and the Flight Director Indicator. A standard R.M.I. compass may be included on the flight panel.

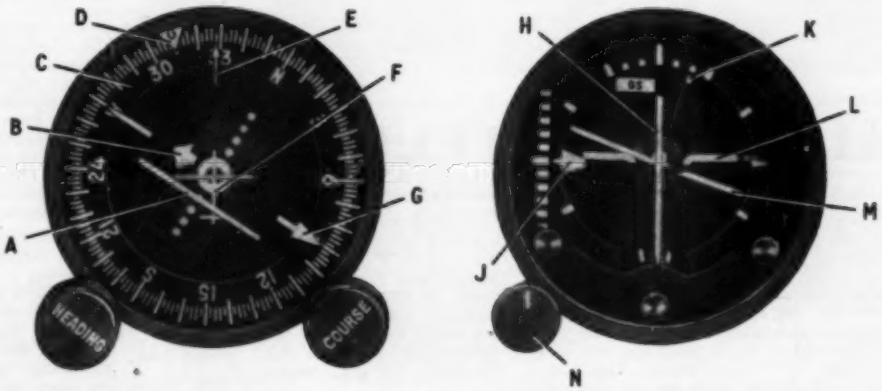
The flight-path indicator combines compass heading, omni-bearing selection, localizer or V.O.R. pointer, glide-slope pointer, and *to* and *from* indication. The heading reference is indicated on the outer periphery of the instrument, and to-and-from flags on the inner dial are visible through arrowhead cut-outs. Displacement of the aricraft relative to the selected course is shown by rotation of the localizer or V.O.R. dial in respect to the selected course on the counter indicator at the top of the instrument. The glide-slope pointer and dial are underneath the localizer pointer dial; when the glide-slope receiver is not in use the pointer disappears, to eliminate confusion when flying V.O.R.

The flight-director indicator provides pitch-and-roll steering commands and indicates attitude by a conventional horizon indication. In addition, slip indication is provided—at the base of the instrument—enabling the pilot to obey the command signals and at the same time performs co-ordinated turns. Indices on the outer periphery of the instrument provide roll-and-pitch commands. When these indices are in line with the aircraft symbol, the pilot is in the proper attitude to correct for the course error. The horizon bar indicates the attitude of the aircraft during the manœuvres. When the flight-director system is not in use the indices move to the neutral position, allowing the indicator to be operated as a conventional gyro horizon.

The Bendix flight director system is standard equipment on U.S.-operated Vickers Viscounts.

Collins Integrated Flight System.—This system was described in detail in our issue of February 11th, 1955. Briefly, the system is based on two instruments, a course indicator and an approach horizon. The course indicator has an arrow which is set to the desired omni-range or localizer course by the selector knob. In combination with this arrow, the course bar and the miniature aircraft (engraved on the instrument glass) show the aircraft position and heading relative to the selected course. Thus, to take a bearing on a V.O.R. station, the receiver is tuned to it and the course arrow rotated until the course bar lines up with it. To select course, the heading marker can be set to a desired magnetic heading by turning the heading selector knob. The selected heading can then be held, with the correct setting on the other instruments, by following the steering needle.

The approach horizon instructs the pilot how to fly in order to turn on to or to hold a radio or selected magnetic heading, while at the same time keeping him informed of his attitude. Steering instructions are provided by the steering needle, which can be used either during normal flying or when on an I.L.S. approach, according to the position of the right-hand selector knob. The horizon bar and the bank pointer together indicate lateral attitude, in the manner of a conventional artificial horizon. The pitch bar, or miniature aircraft symbol, gives pitch attitude information again in the same way as the artificial horizon. The pitch trim knob enables a required pitch attitude to be "zeroed" to make attitude holding easier during an I.L.S. approach. The glide-slope pointer moves up and down the vertical scale to indicate the aircraft's position relative to the glide slope.



A Course bar.
B To-from pointer.
C Azimuth ring.
D Heading marker.
E Lubber line.
F Miniature aircraft.
G Course arrow.
J Glide slope pointer.
K Bank pointer.
L Pitch bar.
M Horizon.
N Pitch trim knob.

The two instruments of the Collins system, the course indicator (left) and approach horizon.

"What's the procedure for a visual approach?"

Extreme contrasts in form and purpose are afforded by these new views of the Fairey F.D.2 supersonic delta-wing research aircraft (reheat Rolls-Royce Avon) and the latest version of the McDonnell XV-1 convertiplane. The XV-1 now has a redesigned pylon cap which materially reduces drag interference between the rotor hub and pylon.

AIRCRAFT INTELLIGENCE

U.S.A.

Boeing B-47 Stratojet. Some hundreds of Stratojets are being fitted at Lockheed's Marietta plant in Georgia with external fuel tanks, which increase their range by several hundred miles. The tanks are fitted between the inboard and outboard jet nacelles, and in the tailcone of each is an 8ft parachute, which pulls the tank away from the wing on jettisoning. The Stratojets receiving the tanks are out of service for only a few hours. They are flown into Marietta and parked on a ramp adjacent to the factory. Using special dollies, workers have the tanks already in position and as soon as a Stratojet is parked work is begun. As many as seven aircraft a day are to be flown in, fitted with tanks, and flown away.

Lockheed Super Constellation. According to *Aviation Week* Trans World Airlines are still searching for a turboprop for their Lockheed 1649A Super Constellations. It seems that the line would settle for an engine with a fuel consumption of 0.5-0.6 lb per e.s.h.p./hr. Lockheed's L-1449 turboprop Super Connie proposal (a forerunner of 1649A) is said to have been cancelled because the fuel consumption of the Pratt and Whitney T34 was 0.87 lb per e.s.h.p/hr.—considered by T.W.A. to be highly uneconomical.

It would appear that T.W.A. have been searching for an *American* turboprop with the characteristics described, for Britain's Napier Eland, Rolls-Royce Tyne and Bristol Proteus and B.E.25 are all capable of meeting or exceeding the specified requirements.

Convair F-102A. Known as the MC-1, a mobile ground-support trailer is being built for the F-102 all-weather intercepter by the Bogue Electric Manufacturing Company. A variety of electrical services is provided: a synchronous motor drives dual generators to supply 37.5kVA., 150/200v., three-phase 400-cycle A.C. power and 500-amp., 28v D.C. current.

Aero Commander. Deliveries of these fast and luxurious executive transports during 1955 totalled 42 Model 560s, 34 Model 560As, and 13 L-26Bs. Output for 1956 is expected to be stabilized at about 12 aircraft a month.

Doman LZ-5. The Civil Aeronautics Administration has now certificated this eight-seat helicopter, and the makers will put production in hand without awaiting firm orders.

Bell X-2. It has lately been disclosed that this ultra-high-speed research aircraft, designed to fly at more than 2,000 m.p.h., flew for six minutes under its own power after being released from a B-50 for its first powered flight last year.

Martin XP6M SeaMaster. Glenn Martin officials report that the recent crash of the first prototype SeaMaster is expected to cause little delay in the programme, and the second machine is expected to fly this month. The wreckage of the first is now being recovered from Chesapeake Bay for assembly at Patuxent Naval Air Station.

Northrop F-89H Scorpion. This version of the Scorpion is similar to the F-89D, which is now in general service, but has provision for carrying Hughes Falcon air-to-air missiles.

Lockheed Supersonic Tanker. A preliminary research and development contract is held by Lockheed's Marietta division for the development of a supersonic jet tanker, but the company is reported to be using some of its own money to render the machine convertible for use as a cargo transport also. A civil derivative will probably be Lockheed's hope as a successor to the Boeing 707 and the Douglas DC-8.

France

S.N.C.A.S.O. Trident. Official trials of the S.O.9000 Trident experimental mixed-power intercepter are continuing at Istres and military pilots of the official flight test centre have made flights under rocket power. Meanwhile the S.O.9050 Trident 2, flown by Charles Goujon, has made its preliminary rocket-powered flights with "excellent results." The second S.O.9050 has been transferred to Istres by road and will soon be in the air.

Hurel-Dubois 321. Powered with Wright 982 C9HE1 Cyclones (nine-cylinder engines developing 1,525 h.p. for take-off) in place of the former 1,200 h.p. Pratt and Whitney Twin Wasps, the Hurel-Dubois 321 has been undergoing performance and handling tests since December 22nd. Initial rate of climb is considerably improved and performance generally has largely borne out the estimates of the design department.

Sipa 200 *Minijet.* Two recently completed Minijet light trainers are now beginning acceptance flights at Villacoublay, where a third machine of the same type is already flying. The original prototype has been handed over by the Air Training and Sports Service in order that the makers may conduct trials with wing-tip tanks, holding 11 gal each. Endurance will thereby be increased to 1¼hr.

Canada

R.C.A.F. Helicopters. The Royal Canadian Air Force is soon to fly the first of its six Sikorsky H-34 helicopters from the Sikorsky factory at Bridgeport to Dorval Airport, Montreal. Already the R.C.A.F. is operating 10 S-55s and is taking delivery of six Piasecki H-21Bs. These last-named machines will differ from the H-21As, six of which were delivered to the R.C.A.F. last year, in being equipped for transport duties instead of search and rescue.

Netherlands

Fokker S.14. A second example of this side-by-side two-seat trainer, considered by *Aviation Week* to be a possible rival of the Beechcraft Model 73 (see *Flight* for January 6th) arrived in the U.S.A. late last month for a demonstration tour of U.S.A.F. and U.S. Navy training bases. In the first S.14 delivered to America Fokker test pilot Gerben Sonderman was killed at Hagerstown on October 20th last.

SHORT SEAMEW

1—*The Design Philosophy*

By DAVID KEITH-LUCAS, B.A., M.I.Mech.E., F.R.Ae.S.*

IT was in 1951 that the Naval Staff, from considerations of the anti-submarine warfare of the late war, concluded that there was a need for a simple, yet fully effective, light aircraft for anti-submarine duties. An aircraft with proper search equipment which could be operated in almost any weather from small carriers would have been of very considerable advantage in the battle of the Atlantic and might have made a great difference to our losses. At the time of the Naval Staff's conclusion, development of radar equipment was tending to outstrip the development of aircraft capable of carrying it and yet of operating from small carriers.

Short Brothers and Harland soon became engaged in design studies of a simple and rugged anti-submarine aircraft, carrying a crew of two (a pilot and a navigator/radar operator), for all-weather operation from carriers of the smallest type. It was to be suitable for production and use in large quantities in time of emergency and therefore the general design-philosophy was one of simplicity, ease of maintenance and low first cost, yet without in any way compromising the military performance which was considered necessary. For example, it was decided that a large type of radar scanner should be fitted, that the bomb bay should be capable of carrying large stores, and that a long patrol performance should be provided.

This initial work eventually resulted in the formulation of a Ministry of Supply specification which was issued to the industry as the basis for a tender design competition. Shorts won the competition with the design which then carried the company's number S.B.6 and is now known as the Seamew.

An Armstrong Siddeley Mamba ASM.6 engine was chosen because the high efficiency of this propeller turbine gave the necessary speed, endurance and small diameter which suited the type of airframe Shorts wanted to design. The ability of the engine to operate on any fuel is a considerable advantage as it does not require the availability of high-octane petrol: and high-octane petrol is never popular on board ship.

Incidental advantages of the propeller turbine engine are that there is no ignition system to cause interference on the radar screen and that the low band of vibrations allows the pilot to be placed on top of the engine, where he gets the best possible view. Great attention was paid to the field of view of both pilot and navigator. All pilots who have flown the aircraft have commented on the remarkably fine view, which is so necessary both for search operations and also for deck landing.

To enable the Seamew to operate from the smaller carriers it was given very short take-off and landing runs. Indeed, it will take off in a 12 kt wind in about 500ft. The stalling speed is correspondingly low and the approach speed for deck landing is very reasonable. Pilots who have flown the aircraft are delighted with the way it flies on to the deck and with the way it can be landed at all speeds.

A fixed and simple landing gear was chosen, as it was thought that a retractable unit was not necessary at the operating speeds. A nosewheel was not used because it would interfere with the radar scanner, but Shorts evolved a system of extending the tail wheel for deck landing so that aircraft could land tail-up and would not have a tendency to "balloon" off again once the wire was contacted. The unit subsequently sinks down to its normal position. The undercarriage was given a very long travel, in order to accommodate a high landing velocity, and this enables landings to be made on the deck in the roughest of weathers. As the aircraft may possibly have to ditch in the sea in emergency, a main-undercarriage jettison system was evolved to avoid any danger of nosing over on contact with the water. It has the incidental advantage of enabling undercarriages to be changed easily.

Although originally it was proposed to have only manual wing-folding, power folding was eventually fitted because the complication and weight penalty was small, and because it is an operationally attractive feature, allowing aircraft to be struck down more quickly.

As mentioned above, the bomb bay is large. The internal length is 14ft and, for an aircraft of this size, very big stores can be fitted. Although no details can be given of the radar equipment it is obvious from the size of the radome that the scanner is of large proportions and obviously able to search with the greatest efficiency.

Short's philosophy of designing for simple maintenance has been used throughout the aircraft. An outstanding feature, made possible by the type of powerplant installation, is the speed with which an engine can be changed. During an official demonstration we have changed an engine and run it again in a total time of 1 hr 20 min, including inspection. There are many access panels and the standard of accessibility is high.

As a result of the programme of strength tests and the results obtained from the Seamew it has actually come out slightly under the original target weight of 14,000 lb with the originally specified stores load. Now, however, the Naval all-up-weight has been increased to 14,400 lb, which is still below the specification figure, to enable the stores capacity to be increased. The R.A.F. version has gone as high as 15,100 lb by eliminating the deck-landing requirement. This enables the aircraft to operate with the maximum of stores and fuel without restriction.

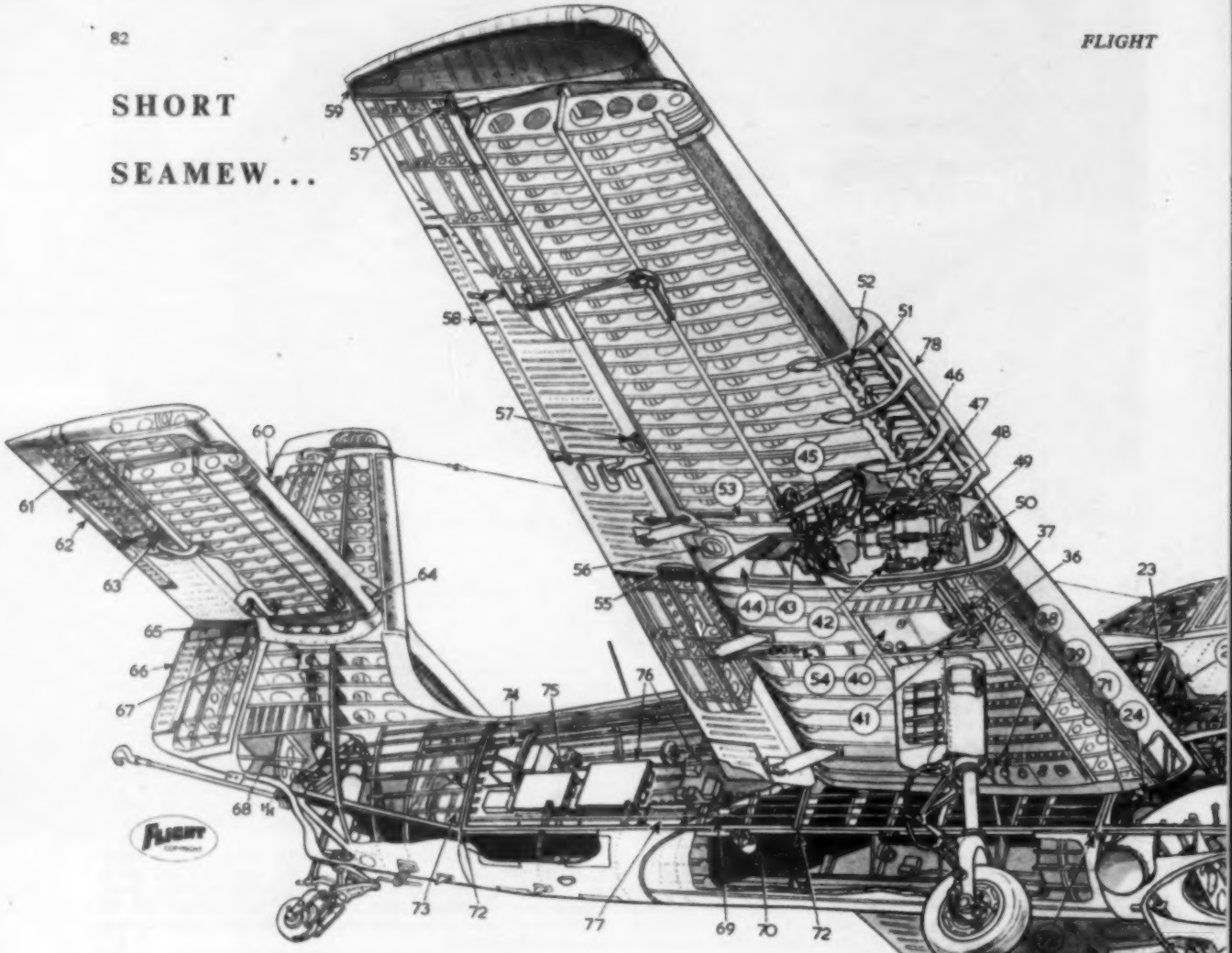
The target was a four-hour patrol at 120 kt, and this has been achieved. As mentioned above, the take-off performance in a 12 kt wind is 500ft and even in still air it is only 300 yd. The total stores load is in excess of 1,800 lb, with some stores carried on the wings, and several combinations are possible, including mines, sonobuoys and torpedoes.

The normal level speed of the aircraft is about 200 kt, but it is cleared to the relatively high diving speed of 325 kt; this is to enable attacks to be made from altitude by diving on the enemy. It is of interest to note that the speed range between stalling speed and diving speed is unusually large for an aircraft of this type. The forward position of the radar scanner ensures that, even in a steep dive, the target is always in the radar view and never blanked by the nose of the aircraft.

The first Seamew was flown 17 months after the order was placed with the company, and the production line is now in full swing. Ten aircraft are now flying. I would like to pay tribute to the staff concerned with the project at the Ministry of Supply. Their co-operation was a real factor in getting the Seamew designed and built in so short a time.

*Director and chief designer, Short Bros. and Harland, Ltd.

SHORT SEAMEW...



1 Tachometer generator.
2 Fire-extinguisher spray ring (zone 1).
3 Starter exhaust.
4 Airscrew control unit.
5 High-energy ignition units.
6 Cockpit air-conditioning intake.
7 Oil-cooler air intake.
8 Fuel pump.
9 Oil cooler.
10 Fuel control unit.
11 Oil-cooler drain.
12 Oil tank.
13 Oil-cooler air outlet.
14 Generator cooling-air intake.
15 Fire-extinguisher spray ring (zone 2).
16 Generator.
17 Vacuum pump.
18 Hydraulic pump.
19 Fire extinguisher bottle.
20 Accessory gearbox.
21 Undercarriage-jettison air bottle.
22 Windscreen de-icing fluid tank.
23 Hydraulic header tank.
24 Fuel recuperator.
25 Aerofoil de-icing control.
26 Windscreen de-icing pump.
27 Wing-fold lever.
28 Emergency flap lever.
29 Parking brake.
30 Hood jettison lever.
31 Undercarriage jettison lever.
32 Control lock.
33 Catapulting hook.
34 Oleo-inflation valve.
35 Brake-pipe coupling.
36 Undercarriage ejector tube.
37 Undercarriage ejector unit.
38 Fuel pumps.
39 Inboard fuel tank.
40 Outboard fuel tank.
41 Wing locking-pin lever.
42 Wing-pin jack sequence valve.
43 Aileron control swivel unit.
44 Wing-fold undersurface flaps.
45 Wing-fold jack.
46 Wing-fold jack sequence valve.
47 Flap sequence jack.
48 Wing-pin jack.
49 Wing-pin external indicator.
50 Outer wing de-icing pipes.
51 Outer wing de-icing boot.
52 Local spar boom.
53 Outer flap jack.
54 Inner flap jack.
55 Flap interlocking dovetail pin.
56 Landing lamp.
57 Aileron mass balance.
58 Aileron trim tab.
59 Hinged glasscloth wing-tip.
60 Upper-rudder anti-balance tab.
61 Elevator mass balance.
62 Elevator trim tab.
63 Elevator trim tab "powerator."

2—*The Aircraft Described*

AS Mr. Keith-Lucas has indicated, the keynote of the design of the Seamew was simplicity, and the entire airframe is therefore built up from standard light-alloy sheet and sections—supplemented by glasscloth—with a minimum of machined castings or forgings. No special machine tools are required for building the airframe, and the job could certainly be tackled by any company with experience of making metal aircraft.

In the wing centre-section, which is built integral with the centre fuselage, there are two spars each with a sheet web and L-section booms. The rear spar slopes forward from top to bottom, the mean depth of the spar lying at 40 per cent of the wing chord. The hydraulically folding outer wings, which taper in both plan form and thickness, continue the main spar to the tip, but embody only a rudimentary front spar consisting of a single boom on the upper surface to accommodate compression loads.

Closely pitched ribs maintain the profile of the flush-riveted skin, there being no spanwise stringers. A photograph shows the manner in which the outer wing is locked in the spread position by a pin close to the front spar; when this pin is removed the wing can be hydraulically folded about the oblique axis of the rear spar to occupy a position parallel to the fuselage, with the upper surface outwards. The wing tips are glasscloth mouldings, impregnated with cold-setting polyester resin. The material is actually "Duraglass" (Turner Bros. Asbestos, Ltd.).

In the design of the fuselage one of the major considerations was to evolve a structure which could withstand the loads imposed by ditching, without nosing over or breaking up. With this in mind, the line of the flooring of the crew compartment

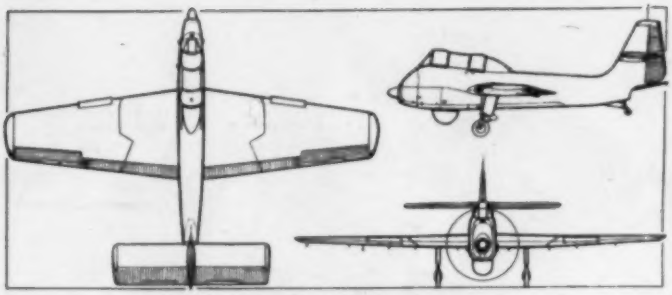
SHORT SB.6 SEAMEW

One Armstrong Siddeley Mamba ASM.6 turboprop. Span, 55ft; length, 41ft; folded span, 23ft; height, 13ft 5in; folded height, 15ft 9in; track, 12ft 10in; gross wing area, 585 sq ft (534.6 sq ft net); dihedral (outer wings), 2 deg 30 min.

Weights (AS.1): mainplane, 2,071 lb; fuselage, 1,122 lb; tail unit, 445 lb; undercarriage, 622 lb; total structure, 4,260 lb. Complete power installation, including cowlings and airscrew, 1,578 lb; fuel and oil systems, 284 lb; power services, 1,549 lb; equipment (including 340 lb de-icing, 110 lb protective services and 760 lb radio and radar), 1,882 lb; contingency addition, 975 lb; basic weight, 9,795 lb. Crew and equipment, 446 lb; oil, stores carriers and other equipment (typical), 134 lb; operating weight, 10,401 lb. Fuel (typical), 2,555 lb; weapons (two A/S bombs and six R.Ps), 928 lb; take-off weight (typical), 13,884 lb.

Weights (MR.2): total structure, 4,365 lb; powerplant, 1,578 lb; fuel and oil systems, 307 lb; power services, 1,465 lb; equipment, 1,668 lb; basic weight, 9,383 lb; operating weight (less carriers), 10,060 lb; fuel (tanks full with Avcet of 0.83 sp. g), 2,930 lb; weapons (four A/S bombs plus eight sonobuoys), stores and carriers, 1,844 lb; take-off weight, 14,834 lb.

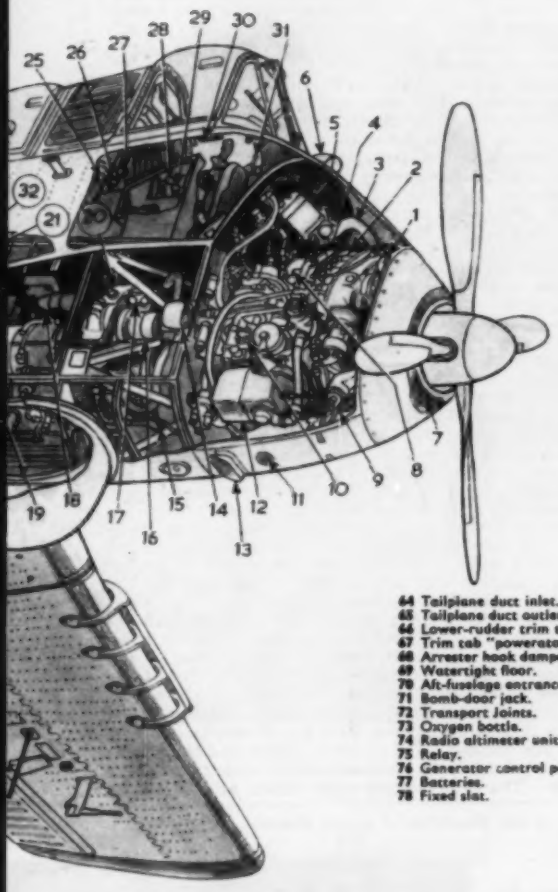
Performance (AS.1): starting at 14,000 lb, take off in 747ft (still air) or 495ft (into 12-kt wind) at 60.7 kt t.a.s.; initial rate of climb, 1,600ft/min; level speeds, 211 kt at sea level or 198 kt at 10,000ft (emergency rating) and 196 kt at sea level (max. cont. power); patrol at 120 kt at 5,000ft, fuel used will be 59 lb for starting and take-off, 64 lb for climb, 2,310 lb for four hours' patrol, 28 lb for descent, and 50 lb for landing, allowing five minutes at 100 kt with 20 deg flap (total 2,511 lb or 326 Imp. gal of wide-cut); landing at 12,900 lb, approach at 15 deg at 65-70 kt and take 1,600ft over 50ft screen (no wind).



ALTERNATIVE WEAPON LOADS

Seamew AS.1	Seamew MR.2
Four 275-lb A/S bombs (1,100 lb.)	Four A/S bombs, Six R.Ps., Eight sonobuoys } 1,844 lb
Two 275-lb A/S bombs, Four R.Ps., Eight 28-lb sonobuoys } (1,026 lb)	
Twenty sonobuoys, Six R.Ps. } (938 lb)	

Loads possible with 17-ft weapons bay	
Three-hour patrol	**Four-hour patrol**
Six 275-lb A/S bombs, Three RPs. } (2,034 lb)	Four 275-lb A/S bombs (1,208 lb)
One 2,000-lb weapon (2,070 lb)	Twenty sonobuoys, Six R.Ps. } (1,111 lb)
Twenty-eight sonobuoys, Six R.Ps. } 1,360 lb	



64 Tailplane duct inlet.
65 Tailplane duct outlet.
66 Lower-rudder trim tab.
67 Trim tab "powerator."
68 Arrester hook damper.
69 Watertight floor.
70 Aft-fuselage entrance hatch.
71 Bomb-door jack.
72 Transport Joints.
73 Oxygen bottle.
74 Radio altimeter unit.
75 Relay.
76 Generator control panels.
77 Batteries.
78 Fixed slat.

is extended to the rear as the "ceiling" of the weapons bay, and is then continued right to the tail to form a watertight horizontal member extending over the full length of the fuselage. All structure below this line is of a secondary nature and can suffer damage without serious consequences to the rest of the aircraft.

The fuselage is built up of one-inch-deep Z-section stringers mounted on the outside of transverse frames of the same depth, some of the latter being channels and the remainder of Z-section. Both the frames and stringers are thus continuous, except where the latter terminate at transport joints or in special cases where load is transferred from the frames direct to the skin. Particularly heavy frames of channel section are situated at the three transport joints (at the front spar, towards the end of the weapons bay and immediately forward of the fin). Fuselage skinning is of conventional riveted sheet, although a portion of the rear fuselage is Reduxed in order to reduce manufacturing costs.

The rearmost portion of the fuselage is built integral with the fin, which incorporates one main front spar and a subsidiary rear spar forming the closing plate to a torsion box completed by the skin, the profile of the latter being maintained by closely pitched ribs. Approximately halfway up the fin are arranged anchoring lugs for the port and starboard tailplanes, which are of constant section and of similar construction to the vertical surface. At the root of each half of the tailplane the undersurface is sharply raked downwards, so forming a duct which improves the airflow over the tail, particularly when flying at high angles of attack. Like the wing-tips, the intake to this duct is moulded in Duraglass. Both the elevators and the two-piece rudder are of simple construction with a fluted metal skin.

Undercarriage design and manufacture have been the prerogative of British Messier; a full description of the main units was contained in our issue of November 20th, 1953. Not only does this undercarriage have to comply with stringent requirements for high rates of descent, but the rebound ratio had to be minimized while at the same time ensuring that the natural frequency of the oleos was very much higher than the motion of a carrier deck under any conditions. British Messier solved this problem by incorporating closure and recoil orifices in a floating damping slot in such a manner as to obtain two spring-rates, one for the static condition and another (a higher rate) in the dynamic, deflected condition. With the aircraft parked, the leg remains in the "high-rate" condition, so that the deflection of the oleo under the influence of deck movements is severely limited. Not only does this design of leg give excellent deck stability, but it also permits a maximum vertical compression of 20in without having to store large amounts of energy.

Each main leg is simply pushed up into the wing to be secured by a special fitting similar to the Messier Jack-Lock. As already noted, this attachment incorporates a pneumatic quick-release actuated from the cockpit so that the complete main units can be jettisoned in emergency. A fork fitting on each leg carries a cast light-alloy wheel having hydraulic blade brakes and fitted with a tyre with a normal inflation pressure of 195 lb/sq in. The Seamew MR.2 is fitted with wider wheel forks accommodating oversize tyres inflated at only 60 lb/sq in, the two sizes of tyre being interchangeable in a matter of minutes.

A very unusual feature is the manner in which the castoring tail undercarriage is permitted, by means of a slow-leaking dashpot, to collapse gently when under load. In the static attitude on the deck the dashpot is completely closed, giving the aircraft a tail-down attitude suitable for catapulting. The unit remains in the "retracted" position until it is released automatically by the selection of "arrester hook down," whereupon it drops into the extended position. In the latter condition the aircraft alights in an attitude not dissimilar to that of a nosewheel-type aircraft, so that there is no likelihood of aerodynamic bounce after hitting the deck. Land-based versions of the Seamew could no doubt incorporate a conventional fixed-position tailwheel, the long-

Accessibility of the Mamba ASM.6 powerplant is of a high order. Also seen open (or removed) in this photograph are the access panels to the starboard accessory gearbox and cockpit instrumentation.

SHORT SEAMEW . . .

travel main oleos and low-pressure tyres being well suited to operation from rudimentary surfaces.

General construction of the ailerons and flaps is clearly shown in the large drawing. The former are of the Frise type, and have an area aft of the hinge line no less than eight per cent of the gross wing area. Each aileron is fitted with a large servo tab and a ground-adjustable tab is also provided. The slotted flaps are arranged in four sections, each of which rotates about a fixed hinge axis below the lower surface of the wing, the position of the axis being so selected as to place each portion of the flap in its optimum position at the landing setting. The arrangement prevents the attainment of the optimum performance at the take-off setting, but the penalty is very slight and has been considered well worth while in the interests of achieving a very simple mechanical design. The total flap area is 166 sq ft and the maximum angle of depression 45 deg.

A small section of fixed slat is provided at the leading edge, in line with the junction between the ailerons and flaps. Each slat is held by four small brackets, those at the extremities sealing the slot to form a box assembly. It has been found that this significantly improves the stalling characteristics, with only a very slight effect on performance.

On the underside of each wing centre-section of the Seamew AS.1 there is a hook for catapulting. A simple sting-like arrester hook is also fitted, the attachment of the hook being shown in one of the two upper illustrations on p. 85. A hydraulic jack is fitted for raising the hook from the dropped position and rebound damping and centralizing are incorporated. Also visible in the photograph is the tongue-fitting which engages the hold-back release during the catapulting sequence.

Owing to the unusual design of the Seamew, and to the slimness of the Armstrong Siddeley Mamba ASM.6* power plant, it has been found possible to accommodate the entire engine bay under the strong ditching floor beneath the crew compartment. The basic engine is built up into an engine-change unit incorporating engine accessories, starter, oil tank, various pipes and cables, the tubular steel mounting structure and all the appropriate firewalls and nose cowling. This complete unit can be removed and replaced with extreme facility, and it is, in addition, readily accessible for routine servicing through the numerous access panels, as indicated in the adjacent photograph.

Starting is effected by a Rotax twin-breech cartridge starter, the exhaust from which is carried round the top of the powerplant to an orifice on the starboard side of the nose. Directly above the front of the engine is arranged a rearwards-facing accessory drive capable of transmitting 100 h.p. Extension shafts transmit this power to a dividing unit which provides power for two gearboxes. Between them, these boxes provide drives for two 6 kW (or 9 kW) electric generators, two Pesco vacuum pumps, one Messier hydraulic pump and one 30 or 40 kVA alternator.

The airscrew is a Rotol product with four solid light-alloy blades and a diameter of 10ft. To reduce airscrew stresses the thrust line is tilted upwards at 2 deg to the fuselage datum, and a Lockheed brake is fitted for bringing the airscrew to rest quickly after shut-down. Exhaust from the Mamba is led away through a downward-curving jet pipe which discharges below the fuselage towards the starboard side.

Basic electrical supplies are drawn from a regulated 28 V direct-current system. The total available power of 12 kW provides approximately 50 per cent reserve over the normal load required for anti-submarine operation. Provision has also been made for an increase in D.C. output up to 18 kW should future requirements make this necessary. Inverters provide various secondary supplies including the following: 360 VA, 115 V, 1,600 c.p.s for radar; a similar supply for special electronic gear; 626 VA, 115 V, 400 c.p.s., three-phase for radar and emergency supplies; and 187 VA, 115 V, 400 c.p.s., three-phase for automatic jet-pipe temperature control and the gyro compass. An *ad hoc* electric supply is also provided for de-icing purposes, and is referred to later.

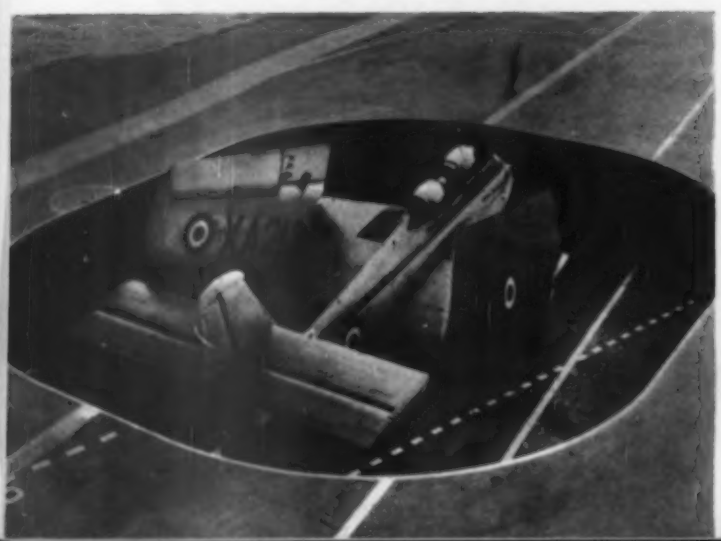
Fuel is contained in four bag tanks housed in smooth-lined containers, two being accommodated in each half of the centre wing. The total capacity is 350 Imperial gallons, excluding air space.

Hydraulic power is provided by an engine-driven Messier pump which energizes the main system at 4,000 lb/sq in. The system is quite conventional and serves flaps, bomb doors, brakes, tailwheel castoring leg, arrester-hook retraction and wing folding. A hand pump provides an emergency source of power, and accumulators are fitted to serve the flap system and also to provide for ten full applications of the wheel brakes.

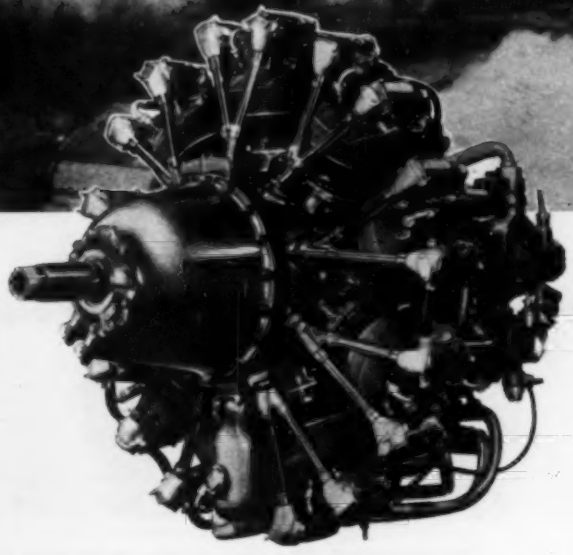
Hot air for the cockpit is drawn from a tapping on the compressor casing of the engine, from where it is fed into the cockpit through a mixing valve which gives manual control of interior temperature. Concentrated jets of hot air are provided for de-misting, and a cold-air system is also included.

Two forms of de-icing are provided. The main aerofoil surfaces are all equipped with pneumatically operated rubber overshoes fed with compressed air from the exhaust side of the vacuum pumps. This type of system was found to be the lightest of the various alternatives available. The airscrew and engine intakes are all de-iced electrically, there being a special 40 kVA engine-driven alternator supplying 400 c.p.s., three-phase current at 115 V for this purpose. The airscrew spinner and blade roots are continuously heated, the remainder of the blades receiving a cyclic supply. The engine-intake guide vanes, aerofoil spokes

**All details of this Mamba are at present withheld.*



Twice last year the Seamew completed carrier acceptance trials from H.M.S. "Bulwark". The aircraft is seen (left) being taken down on the lift with the Mamba 6 still turning. The right-hand photograph shows the starboard wing-fold, the locking unit in line with the front spar being visible on the oblique centre-section terminal rib.



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SHORT SEAMEW . . .

and intake lip are also de-iced from this system. Windscreen de-icing is effected by a manually operated spray of ethylene glycol.

Present types of Seamew are operated by a crew of two, comprising pilot and observer, who are seated in tandem in non-ejecting, 25-g adjustable seats. Both cockpits are covered by jettisonable hoods of blown Perspex, and the pilot's centre-windscreen, which slopes back at 52 deg from the vertical, is so deep that it is provided with twin wipers hinged at the upper and lower edges.

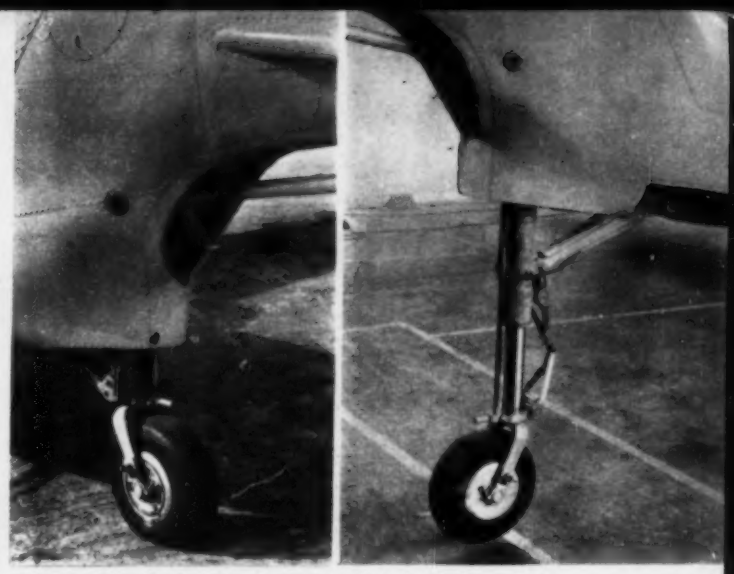
Flying controls are manual and require no explanation. Instrumentation is neat and conventional and the general appearance of the front (pilot's) cockpit is shown by a drawing on page 86. Considerable miscellaneous crew-equipment is provided, including signal pistols, a twin-barrel signal discharger, chartboards for both crew members, smoke/flame floats, a drift recorder and two-stage amber.

Radio and radar equipment is still partly covered by security classification, but the following notes are publishable. A.S.V. radar is fully incorporated, with a rotating scanner housed within a prominent radome under the forward fuselage. With the exception of the indicator and the control unit, the whole of the equipment is accommodated in a hinged bay for easy access. For ground-testing, an adjustable strut can be extended to hold the bay open at 25 deg. The radome is manufactured by Fothergill and Harvey, Ltd., of Manchester, using "Tyglas" resin-bonded glass-cloth. Several additional specialized operational electronic systems are also fitted, or provided for. Other equipment includes V.H.F. radio telephone, H.F./T.R. voice equipment, intercommunication equipment, Mk 5 low-level radio altimeter and a pilot-interpreted short-range navigational aid (either A.R.I.5307 or AN/ARN/21).

Various loads of stores can be carried in the weapons bay and from racks under the centre wing on either side of the undercarriage legs. The main weapons bay is 14ft long, 3ft 1in wide and 1ft 10in deep and is fitted with hydraulically operated, outward-opening doors. In our issue of Febraury 18th last year we published photographs showing six specimen loads which can be carried by the Seamew in its Naval form; typical combinations of stores are listed in the tables on p. 83.

Consideration has been given to the carrying of weapons up to 17ft long by modifying the weapons bay accordingly, at the cost of dispensing with the A.S.V. scanner. The weapons bay is heated by the jet-pipe shroud which passes through its forward end. Droppable stores are selected by cockpit switches and released by a firing button on the pilot's control column.

Design and manufacture of the prototype SB.6 was completed for a very small expenditure. Furthermore, the entire job was completed in only 17½ months from the start of design. The first prototype, XA 209, was first flown by S/L. W. J. Runciman on August 23rd, 1953, and test flying thereafter proceeded with no setbacks worth mentioning. Almost the only superficially evident modification to the aircraft dictated by flight trials was the addition of wing slats and a short length of inverted slat at the roots of the tailplane which was later changed to the internal duct at present used. In 1953 the Ministry of Supply placed a production order for Seamews and this contract is now being fulfilled at the company's works on Queen's Island, Belfast, and at Altona, nearby.



The tail oleo is fitted with a slow-leaking dashpot which permits the leg to collapse gently when under load. Landings are always carried out with the leg extended (right). Also visible are the arrester hook and (beneath it in the left-hand photograph) the hold-back link.

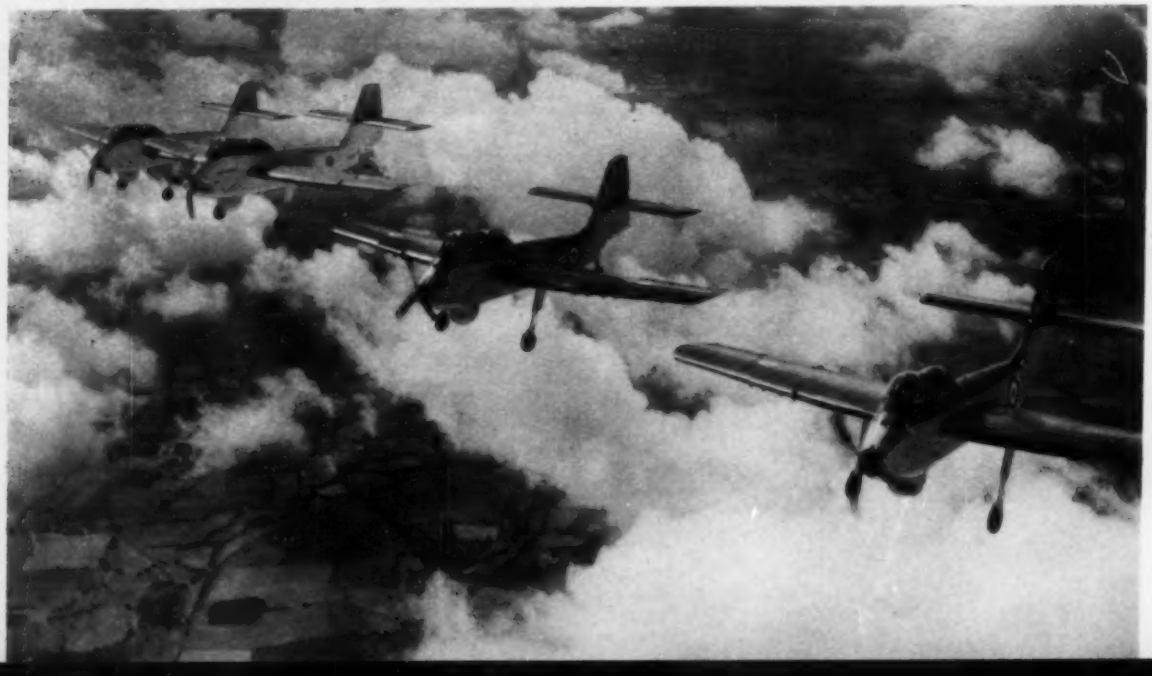
In conformity with its original design function, the first Mark of Seamew to be built was the AS.1 for the Fleet Air Arm, and carrier acceptance trials were very successfully carried out from H.M.S. *Bulwark* in July and December of last year. Meanwhile, last February it was announced in a Defence White Paper that the Seamew would also go into service with Coastal Command of the Royal Air Force. For the latter rôle the MR.2 variant was developed, this being distinguished principally by deletion of the wing-folding mechanism, arrester hook, catapult hooks and other Naval equipment, including certain specialized navigational devices. The MR.2 is also fitted with the larger wheels with low-pressure tyres, and the manufacturers have stated their readiness to incorporate other modifications, should these be necessary for special rôles.

No information has been published of the programme for working up the Seamew with the Fleet, but it has been stated that Seamews are to go into service with Coastal Command within the next few months. The aircraft is also obviously attractive to many other countries, and it may see wide service both as equipment for NATO and as a valuable export item. There is probably no other aircraft less than twice as expensive which could do its job. And its job could clearly include many rôles not envisaged in the original specification.

A particular point worth recording is the fact that the Seamew is at present being built at Belfast for a total expenditure of only 28,000 man-hours per aircraft. This results in the very competitive figure of 6.46 man-hours per pound of useful load—a yardstick which seems to have much to commend it.

In conclusion, reference must be made to the superficial impression made by the aircraft. At first glance it appears retrogressive; and no doubt this is entirely caused by the choice of a fixed under-

A pleasing "Flight" photograph of four Seamews, two AS.1s (foreground) and two MR.2s.



SHORT SEAMEW . . .

carriage. Going further, statements have been made to the effect that it is much too slow and is not altogether a worthwhile machine. Obviously enough, it is one of the slowest fixed-wing combat-type aircraft for many years, but conclusions should not be drawn from this fact without looking into the picture in some detail.

For example, as an in-shore sub-hunter the Seamew can perform duties which cannot, perhaps, be tackled by any other aircraft apart from helicopters, and the latter are both slower and more expensive. Furthermore, the Seamew can operate from the smallest and slowest types of carrier, which can be a very real operational advantage; again helicopters promise to be the only other combat aircraft capable of doing so. The Seamew is not intended to operate in theatres infested with enemy fighters; neither for that matter are most other anti-submarine aircraft. In the rôle for which it was designed, the Seamew meets or exceeds every requirement of its Admiralty specification, and Short Bros. and Harland therefore have every justification in describing the aircraft as being a complete success.

3—*Flying the Seamew*

By W. J. RUNCIMAN, A.F.C., D.F.M.*

THE Seamew was conceived as a simple, rugged aircraft which would give the maximum serviceability with the minimum of maintenance and it was axiomatic that it would have to be as simple to fly as it was to maintain. It is not generally appreciated, even throughout the aircraft industry (except amongst aerodynamic and flight-development personnel), that an aircraft that looks simple is by no means simple aerodynamically. Considerable ingenuity is required by the aerodynamicists and flight-development engineers if it is to meet the stringent requirements of the specification, the handling requirements affecting safety, and (the most important aspect) that, everything else considered, the aircraft should be pleasant to fly throughout its speed range. That the Seamew satisfies all these requirements, yet has a notable stalling-speed to maximum-speed ratio is no mean feat.

From the pilot's point of view the Seamew is extremely simple. The cockpit layout is compact and straightforward, with all the controls and switches readily to hand. The narrow fuselage and the forward position of the cockpit give the pilot an exceptional all-round view. This view has to be experienced to be fully appreciated, and it has not been achieved in any previous single-engined airscrew-driven aircraft, or, for that matter, in any other modern aeroplane.

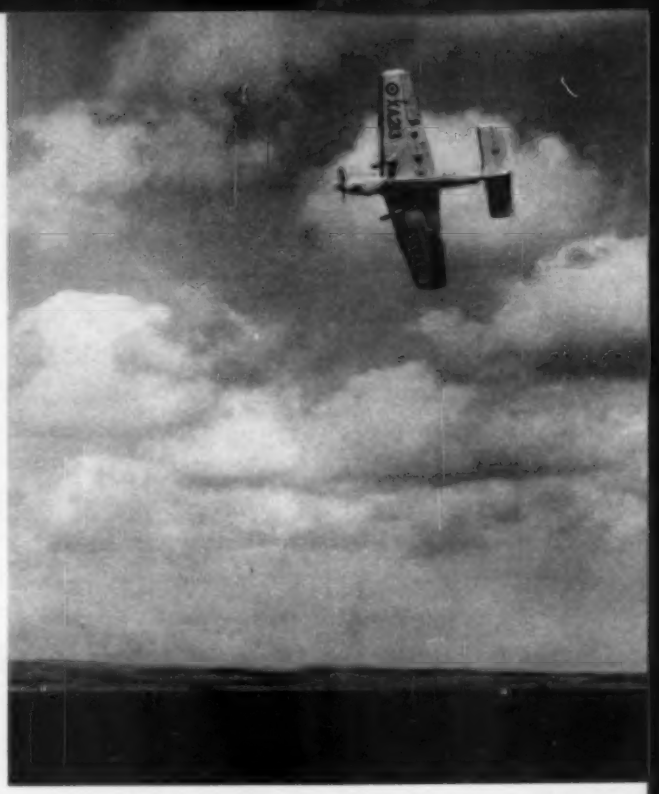
The Mamba is started either by compressed air or by cartridge, and once it is running it is controlled by the throttle alone. The engine has ground- and flight-idling positions, and from flight-idling power to full throttle there is no restriction in the rate of throttle application. The engine is amenable to the heaviest of heavy-handed pilots.

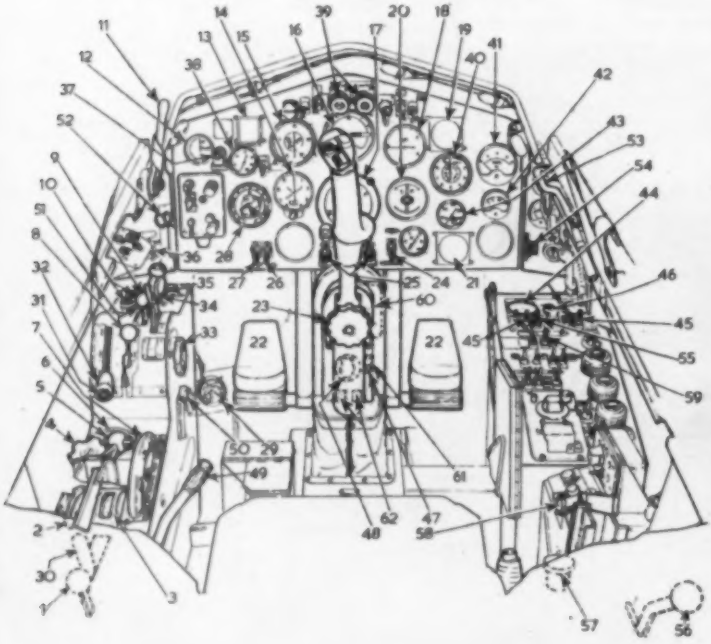
Take-off and the landing are simple and straightforward and, despite the high engine-power available, there is no tendency to swing in either case. The aircraft flies itself off in a very short distance and, regardless of the speed or attitude on landing, settles down and stays down. The long-stroke undercarriage absorbs the touch-down without the slightest tendency for rebound—it is, in fact, impossible to bounce the Seamew.

In the air the pilot feels at home immediately and only the minimum of attention is needed to maintain the required course. Even in very bumpy conditions the Seamew almost flies itself, allowing the pilot to make the most of the exceptional visibility for searching. This characteristic does not impair manœuvrability, which can only be described as "lively," with the ability to turn on a pin-head, as well as a high maximum rate of roll and a wide speed range.

The outstanding features of the aircraft are its behaviour in a cross-wind and in poor air-to-ground visibility. There is little doubt that the average pilot will be able to deal with cross-winds up to 20 kt at 90 deg, and more experienced pilots will have no difficulty with larger cross-wind components. The slow stalling speed (50 kt at the maximum landing weight) and the power available in the landing configuration, where only 50 per cent power is required to maintain level flight, will allow the pilot to make tight circuits in extremely poor visibility without anxiety. In general, the Seamew is simple to fly, vice-free, and very easy to get to know. Service pilots should enjoy flying it.

* *Test pilot, Short Bros. and Harland, Ltd.*





This drawing shows the pilot's cockpit of a Seamew AS.1. View is outstanding in all directions through distortion-free panels.

1 Parking brake.
2 Tailwheel castoring lock.
3 Elevator trim-tab indicator.
4 Rudder trim wheel.
5 Flaps down (emergency) lever.
6 Rudder trim-tab indicator.
7 Elevator trim wheel.
8 Flap control lever.
9 Flying-controls locking lever.
10 Tail-leg dashpot indicator lamps.
11 Undercarriage jettison lever.
12 Flap-position indicator.
13 A.S.I. correction-card holder.
14 Altimeter.
15 Airspeed indicator.
16 Artificial horizon.
17 Gyro compass.
18 Rate-of-climb indicator.
19 E. 2A compass deviation card holder.
20 Turn-and-slip indicator.
21 Gyro-compass deviation card holder.
22 Wheel brake pedal.
23 Aileron bias control.
24 Gyro-compass selector switch.
25 Power-failure warning lamps.
26 Radio-altimeter switch.
27 Contact-altimeter switch.
28 Contact altimeter.
29 Brake triple-pressure gauge.
30 Low-pressure fuel cock.
31 Flight restart push-button.
32 High-pressure fuel cock.
33 Throttle-lever friction adjuster.
34 Throttle lever.
35 Ignition master switch.
36 Airscrew fine-pitch master switch.
37 Reverse-torque warning lamp.
38 Torquemeter pressure.
39 Fire-warning lamp and extinguisher button.
40 Tachometer.
41 Jet-pipe temperature gauge.
42 Oil-temperature gauge.
43 Oil-pressure gauge.
44 Fuel contents gauge.
45 Fuel-pump motor switches.
46 Fuel-pressure warning lamp.
47 Engine-starting master switch.
48 Engine-starter push-switch.
49 Hydraulic system hand-pump.
50 Bomb-door control.
51 Arrester hook indicator lamps.
52 Arrester hook control lever.
53 Hood-jettison lever.
54 Armament sight switch.
55 Battery master switch.
56 Aerofoil de-icing control.
57 Windscreen de-icing pump.
58 Wing-fold lever.
59 De-icing master switch.
60 Oxygen regulator.
61 Instrument A.C. power switch.
62 Generator switches.

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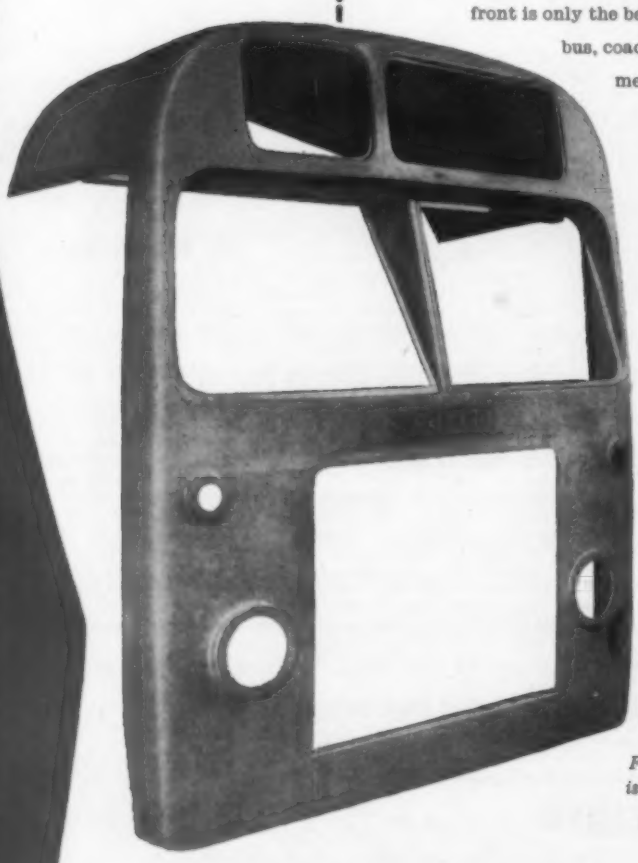

The complex curved front of this single-decker model S.14 is moulded in one piece of Fibreglass reinforced plastic. Yet the front is only the beginning of the story. Right down the bus, coachwork curves are shaped without mechanical aid, without high pressures—with F.R.P. This easy method is saving the Birmingham and Midlands Motor Omnibus Co. Ltd. up to 50% on certain former construction costs. It is reducing fuel consumption too.

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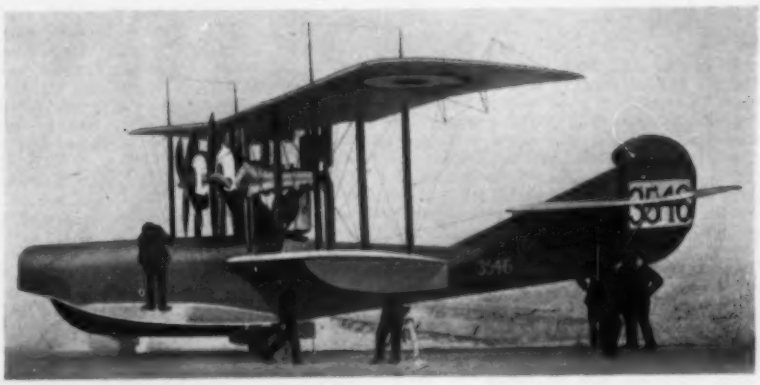
F-BOATS

—a postscript by an ex-pilot



A pictorial postscript to Mr. Bruce's series on the Felixstowe flying-boats is added by this rare photograph of No. 3546, known as the "incidence boat"; it was powered by two Clerget rotary engines. The illustration is provided by the librarian of the Royal Aeronautical Society.

FOLLOWING publication of a three-part article on the Felixstowe flying-boats, by J. M. Bruce, M.A., a most informative commentary has been received from Professor E. A. G. Robinson, C.M.G., O.B.E., and is printed here, together with a further note by Mr. Bruce. Prof. Robinson, who is Professor of Economics at Cambridge University, served as a pilot in the R.N.A.S. and R.A.F. during World War I.

AS one of those who flew the H.12s and F-boats in 1917-19, I wonder whether I may express my gratitude both to *Flight* and to Mr. J. M. Bruce for the three fascinating and authoritative articles that you have lately printed. Even to one who thought he knew those boats fairly intimately the articles have added a great deal of new detail, particularly about the early period of Felixstowe design work. These boats have suffered so badly from mistakes repeated from one book to another that a really authoritative record was badly needed. Even such a careful and well documented book as Thetford's and Riding's *Aircraft of the 1914-1918 War* has a number of rather serious mistakes.

Having said that, may I be allowed to suggest a few very minor additions or corrections to Mr. Bruce's articles? First, the common belief that all F-boats were F.2As is perhaps a little more forgivable than might appear. The famous and well publicized stations were Felixstowe and Yarmouth. Even in the autumn of 1918, apart from a few surviving H.12s and H.12 converts (H.12s rebuilt with an F.2A or H.16 hull) and the prototypes F.2C and F.5, they possessed scarcely anything but F.2As and hardly any F.3s; Felixstowe had, I think, a couple. In the second half of 1918 it became my job, after Killingholme was taken over from us by the U.S. Navy, to test and ferry F-boats from builders' works to the stations where they were being flown. Almost all the F.2As were going to Felixstowe, Yarmouth, Dundee, Calshot (and earlier, also, to Killingholme). The F.3s nearly all went to Cattewater, and the Scillies, and to Houton Bay in the Orkneys. The reason is obvious: the F.2A was faster, the F.3 had the bigger fuel capacity and boat load. The F.2As went (apart from Calshot, which was within a few miles of where they were building at Cowes and Hythe) to the stations in the areas where reconnaissance, Zep-chasing, and fighting were most important. The F.3s went to the stations where the main emphasis was on submarine patrol.

Mr. Bruce has emphasized the weak points of some of the earlier F-boats, and in particular of the F.3s. I do not think that it emerges quite clearly from his narrative that progressively during 1918 the boats coming off the production lines were modified to remove some of the more serious weaknesses. The early boats were all enclosed, so that the pilots had no backward view. From about September 1918 most of the new F.2As were open boats, somewhat faster in consequence, and with a good view for the pilot. At the same time, they had mahogany tail planking (Consuta sewn planking in the Saunders boats) instead of the narrow washboard and fabric which had given so much trouble at stations where sea conditions were less favourable than at Felixstowe.

They also, from about the same date, had horn-balanced ailerons, making them somewhat less tiring to fly than the H.12s and early F.2As; to fly one of those for eight hours with no balance anywhere in the controls, and usually with a considerable tail-heaviness half-corrected by a rubber cord, was an extraordinarily tiring job, and pilots were apt to fold up after a few months of it. One of the most important improvements on the F.2A as compared with the H.12s was that the F.2A had an ingenious arrangement for dual control; the second pilot's control wheel could, when necessary, be disconnected and laid flat so that one could climb over it into the front cockpit. The H.12 had no dual controls, and one pilot had to climb out of the seat and let the other climb in. Since there was no time to change pilots in an emergency landing from normal patrol height, and H.12s were impossibly difficult to land in a rough sea, the first pilot would often fly the whole patrol on a bad day, and get home dead beat. Apart from that, the dual control in an F.2A allowed the first pilot, if he preferred it, to let his second pilot do most of the flying and himself take most responsibility for the navigation. In an H.12, with an inexperienced second pilot it was not easy both to fly and to navigate, and one wondered occasionally whether it was better to risk being killed or being lost.

These official modifications of late 1918 lead one on to the unofficial modifications. To a generation which takes the minutest change in the design of an aircraft with appropriate solemnity, the cheerful abandon with which any station and almost any pilot made private and major modifications to suit individual tastes must seem unbelievable. Felixstowe itself led the way. If in the autumn of 1918 one arrived with a new enclosed boat it was hardly ashore before the chippies had removed the greenhouse and had started to convert it into an open boat. Both at Felixstowe and elsewhere a number of boats possessed ailerons, rudders and even elevators which differed greatly from the standard. Porte was reputed to frown on too-powerful controls, which might enable one to throw about a not-very-strong aircraft (an H.16 was actually looped by an American pilot at Killingholme), but tired pilots on long trips took a very different view of what was desirable.

All this is admirably illustrated by the photograph at the top of page 931 of *Flight* for December 23rd, 1955. Whatever N.4060 may have been, she was not a standard H.16. My own belief is that the top photograph on page 895 (December 16th) is an H.16. Her number—more legible in Thetford and Riding—in the 4300s seems to support it. The H.16s were enclosed boats with a clear gap down to the main longeron between the deck fairing and the windscreen, and with veneer instead of planking on the nose. (The photograph of a supposed H.16 in Thetford and Riding, 1946 edition, page 95, is of an early type Porte Baby.) The U.S. Navy had some fifty or more H.16s at Killingholme with 330 h.p. low-compression Liberties. The boat on page 931 may possibly have started life as an H.16; but she has fallen into the hands of a first pilot who has views of his own about open boats, balanced ailerons, a balanced rudder, and balanced elevators, but curiously (suggesting a Felixstowe home) without views about washboards and fabric on the tail.

And just as the F.2As came in for a good deal of modification, so did the F.3s. Mr. Bruce has emphasized the weakness of the hulls. On at least one station, where they often had to be bounced off a long swell, it was found that the planking was apt to open up from the keelson. A new boat on arrival would very probably be dismantled and the petrol tanks removed, to permit a series of oak knees to be put in to strengthen and hold together the bottom planking. If, as was not infrequently the case, the hull builders had put on the diagonal double bottom planking the wrong way, so that the water flow was across the outside skin of planking and not along it, the whole bottom would be removed and replanked. At the same time the tail fabric would be replaced with ply-board. All this made the boats stronger but heavier, and sometimes wildly tail-heavy. I wonder whether the almost unbelievable difference between the supposed empty weight of a production F.3 and that of a production F.5 given on page 932 existed in reality.

I tested and delivered all the early F.5s built by Shorts at Rochester, including N.4041 and N.4044 which Mr. Bruce mentions, as well as a great many F.3s. There can be no possible question of the markedly superior performance of the F.5s. The average F.3 had a maximum speed around 78 kt; the best I ever flew, N.4250 built by Dick, Kerrs at Preston and erected at South Shields—subsequently a favourite at Cattewater—did 83 kt on test. Lankester Parker and I timed one of the early Short F.5s (N.4047) to do just under 90 kt, which is very close to the prototype's speed and far in excess of the 88 m.p.h. (76 kt) given on page 932; both take-off and climb were also much better than for the contemporary F.3s.

The endurance figures given on page 932 (*Flight*, December 23rd) need a little qualification. The F.2A carried with full tanks

F-BOATS . . .

about 315 gal and the F.3 a little over 400 gal. With full bomb load the F.2A ordinarily carried 250 gal and the F.3 about the same. The normal habit was to cruise at 60 kt, at which consumption was about 33 gal/hr; some of the Cattewater F.3 pilots cruised at speeds as low as 55 kt to get longer endurance on submarine patrols and at that speed N.4250 was reputed to consume about 25 gal/hr. I do not know the longest recorded flight on an F.3; there were flights of over 9½ hr on F.2As from Dundee and Killingholme, and many others of over 8 hr, but on some, at least, of these flights extra petrol was carried in cans and poured into the tanks. Even apart from such chores, the job of the flight engineer was by no means enviable. The unspeakable petrol system, with its windmill piston pumps, for which the rest of us blamed the prejudices of Felixstowe, very often meant that the later parts of the flight depended on hand pumping; if (as happened not infrequently) a petrol pipe broke, the engineer was more or less expected to climb out in the air and do his best to repair the pump with insulating tape while clutching as best he could on to the flying wires or the engine struts. All the boat pilots of that generation remember their flight engineers, as well as their wireless ratings, with admiration and gratitude.

The serial numbers given on page 932 would provide for a little over 350 boats. Only a fraction of these were actually built and delivered before November 11th, 1918. Mr. Bruce gives a total of 104 Large Americas of all kinds, clearly including H.12s, to the end of May 1918; he gives 53 F.2As and 60 F.3s (including the 18 with the Grand Fleet and Northern Patrol at Houton Bay and the 13 in the Mediterranean) on charge to stations at the end of October 1918, and a further 36 in store or at contractors. By then the rate of building was about 10 to 12 a week. I doubt whether more than some 200 boats were actually built during the war. The majority of casualties, otherwise than by enemy action or very bad crashes, were recovered and repaired; only four are shown as having been written off during October 1918. This roughly accords with a total that can be got from the serial numbers. The earliest F.2A series were N.4510-9 (May, Harden and May) and N.4280-4309 (Saunders). May, Harden and May went on to the N.4530-54 series (a number of the Felixstowe and Yarmouth boats are in this series). At the end of the war they were beginning the N.4480-4504 series; I was delivering N.4484 to Dundee on Armistice Day. Saunders at the same time were in the N.4430-79 series: N.4433 was delivered shortly before the end of October. Of the F.3s, Shorts had reached about N.4025, and Dick, Kerrs about N.4265 by the end of the war; I seldom flew the Phœnix boats and have no record of their progress, but I believe they had just about finished the N.4400-29 series. I think that a little over 100 F.3s and a little under 100 F.2As is not far off the right total of production during the war itself. Considering their numbers, they made their presence felt very effectively. As late as May 1918, the number of qualified first pilots on any station other than Felixstowe was often no more than six to eight.

Finally, may I add to the list of individual machines those that were at Killingholme up to June 1918? H.4s: N.1232, N.1233, N.1235. H.12s (early type): N.8668, N.8669, N.8688. H.12s (later type): N.4336, N.4343, N.4348, N.4350. F.2As: N.4516 (built by May, Harden and May) and N.4287, N.4290 and N.4291 (built by Saunders); the last of these is wrongly included in Mr. Bruce's Yarmouth list; I helped to collect it from Cowes in April 1918, and flew it fairly frequently during the following three months; it was in N.4291 that Capt. T. C. Pattinson and his crew shot down L.62. One or two of the H.12s were then or later rebuilt with F.2A hulls and all had received Eagle VIIIs.

In addition, there were a number of Porte boats, of which two or three were re-engined during the summer of 1918 with Eagle VIIIs; they were never used from Killingholme on serious military operations, but it was proposed to transfer some of them to the new station at Catfirth in the Shetlands which was being opened with a nucleus of R.N.A.S. staff from Killingholme; since the two Porte boats surviving at October 31st, 1918, to which Mr. Bruce refers are shown in Appendix XLI of *The War in the Air* as on charge to the Grand Fleet and Northern Patrol I would guess that this accounts for them. An air photograph of Killingholme taken during the American period shows three more of them lying paparently derelict behind the sheds.

One wonders in retrospect why no one tried to do for the wing structure of the F-boat what Porte succeeded so remarkably in doing for its hull. By the end of 1918 the F.5 represented a 1914 wing structure on a 1918 hull. The improvement which Gouge managed to make between the rather similar Short Cromarty, building in 1918, and the Singapore (with the same engines) of a few years later shows what a little cleaning-up might have done. An extra 10 or 15 kt would have given the boats the initiative against the Brandenburgs, and would have enabled them to fight or avoid fighting as circumstances required. As it was, the only possibility was to crowd on armament and make them slower.

FURTHER COMMENT ON THE F-BOATS by J. M. BRUCE

IN the foregoing notes Prof. Robinson has made an indisputably authentic and admirable contribution to the history of the Felixstowe flying-boats. As I found to my concern, comparatively little has been recorded about these fine aircraft.

Prof. Robinson's remark about the horn-balanced, constant-chord ailerons of the later F.2As confirms a suspicion of mine, for there are one or two photographs of Felixstowe boats which obviously had such ailerons yet did not have F.5 tail units. I suspected them of being modified F.2As but lacked confirmation.

Whether N.4060 was or was not a standard Curtiss H.16, it was originally ordered as such. It was one of fifteen, numbered N.4060-N.4074, ordered for the R.N.A.S. from the Curtiss concern. Certainly the illustrations of a basic H.16 which appear in the 1919 and 1920 editions of Jane's *All the World's Aircraft* depict an enclosed boat as described by Prof. Robinson. Without being quite certain of the serial number of the boat in the upper illustration on page 895 of *Flight* it is impossible positively to identify it, but I think the odds are against it being an H.16.

Prof. Robinson's comparison of the performances of the F.5 and F.3 is interesting. The figures I quoted were taken from official trial reports as follows: Production F.3—Report No. N.M.155, dated 29.4.18; Prototype F.5—Report No. N.M.165B, dated 9.5.18; Production F.5—Report No. N.M.248A, dated May 1919. In particular, it should be noted that the endurance figures I quoted were in each case directly related to the fuel load specified, and were not maxima. These trials were, of course, conducted with individual aircraft, but their inclusion in the Directorate of Research Record of Performances of British Aeroplanes seems to indicate that they were intended to be regarded as typical.

On the question of the empty weights of the boats one must, of course, accept at their face value the weights quoted in the official trial reports; but the F.5 hull was specifically referred to in the discussion which followed Major J. D. Rennie's lecture, entitled *Some Notes on the Design, Construction and Operation of Flying Boats*, delivered to the Royal Aeronautical Society on January 18th, 1923 (Journal of the Society, 1923, pages 123-181). There (page 171), Mr. W. O. Manning is quoted as saying: "As to hull weights, the Author's [Maj. Rennie's] F.5 weight referred to the special F.5 built at Felixstowe (i.e., the prototype), and not to the standard F.5 as used. He did not know the exact weight of the latter hull, but it was approximately 2,500 lb, or 1,000 lb more than the other." To which Maj. Rennie replied (page 178):—

"Mr. Manning challenges the percentage weights of the F.5, and says the hull had to be considerably strengthened to make it fit for general service. As I was chief technical officer at Felixstowe, and therefore in a position to know accurately the history of this boat, I must contradict him. As I have already pointed out, this boat had been used extensively, and was well-known to be the best hull turned out at Felixstowe.

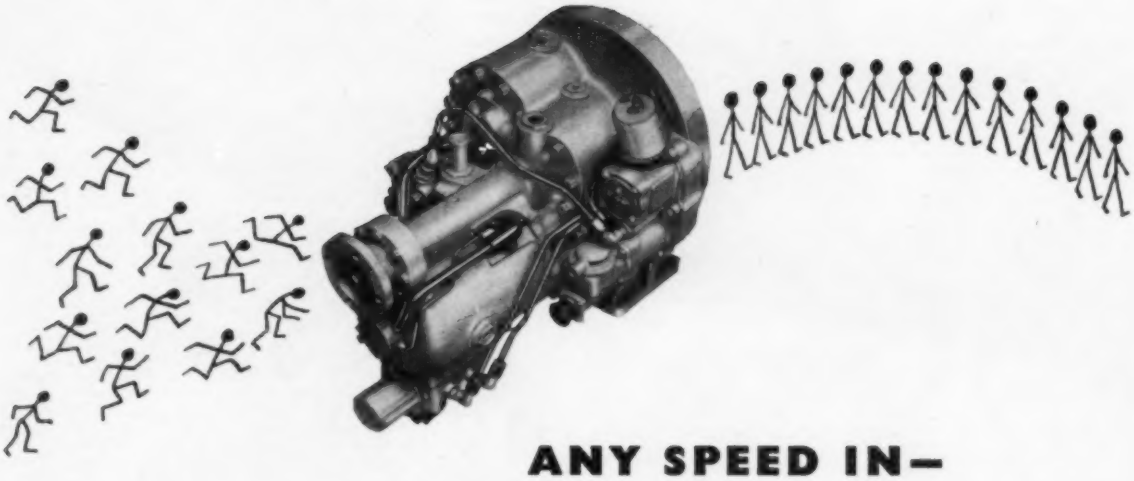
"The F.5 was never put into production, which was a great blunder on the part of the Production Dept., Ministry of Munitions. Instead, the F.3 wing structure, the weight considerably increased to facilitate production, and adapters fitted to take either streamline wires or stranded cables, also permanent slinging gear incorporated, was fitted to a mongrel hull, a cross between the F.5 and F.3, and the resulting boat called the F.5. This was done solely because the F.3 was already in production (it never should have been), and the Ministry of Munitions were against a further change as jigs, templets, etc., were already made for the F.3. Therefore Mr. Manning's figures for weights of the F.5 are not accepted for two reasons: firstly, they do not represent the F.5 and, secondly, the hull weight includes bulkheads, seats, etc., and consequently is not comparable with the figures given in my paper."

In this lecture, Maj. Rennie confirms Prof. Robinson's opinion that some 200 F-boats were actually built. On page 175 of the R.Ae.S. Journal he says: "During the war about 500 'F' boats were ordered from various firms. Of these, say, 200 were delivered and used up to the Armistice, after which a certain number were cancelled and the remainder delivered to stores."

The serial numbers I gave on page 932 of *Flight* were neither complete nor exhaustive; it was not my intention to convey the impression that all the machines listed were actually completed.

The addition of the serial numbers of the Killingholme boats is of interest, but the H.4s were properly 1232, 1233 and 1235; and the early H.12s, 8668, 8669 and 8688. Although these aircraft may have appeared with the N prefix, they did not properly belong to the true N series. (There are many other examples of this misleading use of the N prefix.) As for N.4291, might not that boat have been transferred to Yarmouth?

A final point in my own article which I should now like to correct is that the American N.C.4 flying-boat which was the first to make the Atlantic flight was one of three, not four as I stated.



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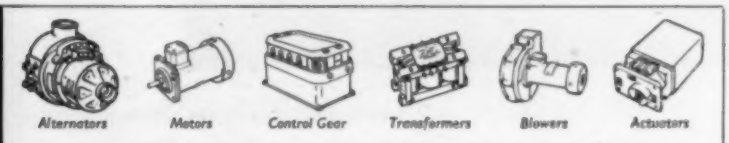

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The Aeroplane

The Short Seamew is Britain's newest light anti-submarine aeroplane. Developed for the defence of sea communications and coastal water, the Seamew is an all-weather aircraft, capable of carrying out its duties under the most hazardous conditions. It possesses exceptional manoeuvrability over a wide speed range. Specially designed for mass production, its simplified construction reduces time and cost of maintenance to a minimum. Power unit is a single Armstrong Siddeley Mamba Turbo-prop engine.

The Pilot

Squadron Leader W. J. Runciman, A.F.C., D.F.M., joined Short Brothers & Harland Limited in 1952. During the war he served in Bomber Command and 2nd T.A.F., whilst a member of the R.N.Z.A.F. Since the war he has worked with Central Bomber Establishment, completed the Empire Test Pilots' School course, and served with A. & A. E. Establishment, Boscombe Down. His flying with Shorts has included development work on a variety of aircraft, including the S.A.4 Sperrin Bomber and the Seamew. Squadron Leader Runciman says " Shell and BP Aviation Service has always given me the utmost co-operation ".

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

A D.H. Veteran Still Flying

ENCLOSED is a photograph [reproduced above.—Ed.] which you may be interested in publishing. It is of a D.H. 51 which started life as G-EBIR after being built by de Havillands at Edgware in 1925. It has the constructor's number of 102 and is fitted with an Airdisco-modified Renault engine of 120 h.p.

It was imported into Kenya in 1928 by a Mr. J. E. Carberry and, as it was the first registered aircraft in Kenya, he named it aptly *Miss Kenya*. The aircraft still bears this name. It had three other registered owners pre-war, Messrs. T. Black, G. Skinner and A. Hughes in 1929, Messrs. G. Skinner and A. Hughes in 1932 and Mr. D. A. G. Onslow in 1933.

I have been unable to ascertain its war-time history, but I did find out that the C. of A. expired on May 12th, 1936, so it is quite likely it was stored for a considerable time. In 1950 it was again registered, this time to a Mr. C. F. Baudet, who in 1951 handed it over to the R.A.F. for a museum-piece.

In September 1955 it was again registered, this time to J. S. le Poer Trench and partners, who have made it airworthy; but it only flies on a Permit to Fly. I was talking to one of the owners who said they hoped to fly it to Kitale for the Kenya Air Show on January 7th.

London, W.6. PETER R. KEATING.

Vanguard and Britannia

YOUR correspondent J. Rodgers (December 30th) is perhaps open to correction in saying that "the Vanguard would appear capable of doing most of the things which a Britannia can do, plus a lot more" and we are grateful to you for your appropriate footnote to his letter. The two aircraft are, of course, designed primarily for two different types of operation—the Vanguard for short- and medium-stage routes, the Britannia for intercontinental and trans-ocean operations.

In your issue of October 21st the Vanguard's performance is quoted as follows: "93/105-seater for very-high-density routes, cruising at 400-425 m.p.h. on stages varying from 500 to, ultimately, 2,500 miles." The Britannia 100, which it should be remembered is the first of a developing family of Britannias, and deliveries of which to B.O.A.C. have begun, has a greater payload capacity than the Vanguard, cruises at nearly the same speed, yet has a range ability nearly twice that quoted for the Vanguard. We think it also worth making the point that the direct operating costs of the Britannia remain exceedingly low even down to ranges of the 600-mile order.

The later series Britannias offer even greater work capacity and higher performance, without penalizing the low level of operating costs.

Filton, Bristol. C. B. BAILEY-WATSON.
Public Relations Manager, Bristol Aircraft, Ltd.

Capt. Percival's New Venture

IT is indeed refreshing to see Capt. E. W. Percival's return to aircraft manufacture as shown in the two recent issues of *Flight*.

I, along with others formerly connected with his pre-war enterprise at Luton are glad that this pioneer aviator, of courage in flying and aircraft design, is again in the front, where he rightfully belongs, to give us aircraft designed for peaceful and useful purposes—as were the elegant Q.6s and Mew Gill, etc.

There is no doubt that there are tremendous possibilities and endless tasks for the "Flying Jeep" in this country and abroad. Good luck, Capt. Percival!

Luton. DOUGLAS E. KILBY.

IT looks as if Capt. Percival has produced a winner in his P.9—with possibly more adaptations than are obvious at present.

One version I would like to see would be adapted to contain one of the little Messerschmitt three-wheel runabouts. The rear door would have to accommodate a ramp and the tail would have to be lifted somehow, perhaps by using a nosewheel. But what a boon to the private owner and his wife or the aerial salesman! Complete mobility at last!

If it were possible, I imagine such a version would have a ready sale abroad.

Hamble, Hants. L. A. FIELDHOUSE.

More About F-Boats

IN the interests of historical accuracy some minor corrections apply to your most interesting recent articles dealing with the early type flying-boats. I feel sure that Mr. Bruce is in error in quoting that Maj. R. Moon met his death while attempting to take-off in the Felixstowe Fury. I was present at Felixstowe in the early part of 1920 (several months after the Fury had crashed whilst taking-off for an overseas tour—without crew loss, I believe) when Maj. Moon had the sad misfortune to crash an F.5 with the loss of three lives, including his own. I am fairly confident that the Fury was not flown after 1919—if one still existed then.

I take leave to doubt the maximum speeds quoted for the F.2s and F.5s at 2,000ft—95 and 88 m.p.h. respectively—and also the ceilings, for production types. Although I flew from 1919 to 1926 as a crew member in F.2s and F.5s I cannot recall ever reaching such dizzy pinnacles of 10,000ft in either type and certainly we never charged through the air at more than 65 kt maximum—the usual cruising was nearer 50-55 kt in still air at 4,000-5,000ft; how very grateful we were for even the lightest of tail winds! With a crew of five plus full load of fuel, etc., few F.5s ever got higher than 5,000ft, and they took a long, long time to get that high. However, the boats were grand aircraft of their day and gave some fine service in war and peace.

It may also be of interest to record that the F.5 was probably the first aircraft to be fitted experimentally with the Robinson D/F loop. The loops were fitted into the extreme after part of the hull, with manipulating gear extending through the companion way to the W/T. cockpit to starboard and immediately aft of the pilot's position. A compass rose was fitted to the control end of the loop driving-shaft to enable bearings to be observed forward. The system was very unwieldy in operation, but once skill had been obtained in the use of the system an acceptable degree of accuracy was obtained. Ground D/F development led to the system becoming obsolete.

The domestic possibilities of the varied types of flying-boat hull were quickly realized, resulting in several "houseboats" making their appearance upon the waterways of East England shortly after the first world war ended, manned by ex-R.N.A.S. personnel. Also, the wing-tip floats made quite reliable sailers and could take two men in safety in a calm sea; they were somewhat cumbersome but used with a square sail could make headway at 4-5 kt. A Maj. Modin was the first officer at Felixstowe to realize the possibility of constructing houseboats from hulls and I remember seeing his quite practical and comfortable conversion job with some envy!

Sellindge, Kent. LANCE R. RUDD.

[A commentary on Mr. Bruce's articles appears on pages 87-88 of this issue.—Ed.]

Blast Effect

THE note in your issue of December 30th last on the appointment of Mr. N. Elliott Felt, Jr., as operations manager of Project Vanguard states that "he served for 2½ years as an infantryman during the late war and is well known in the field of rocketry."

Lest this give the impression that the infantryman is more exposed to corrective blasts than is his counterpart in other armed Services, may I say that I was privileged to serve in the Royal Air Force for several years, in the course of which I got quite a name for collecting rockets from one source and another, some of quite startling intensity?

London, W.1. O. W. H. COOKE.

[But, surely, whereas the soldier collected "rockets" and the sailor "bottles," the airman merely lost "strips"?—Ed.]

IN BRIEF

In Mr. David Ogilvy's letter last week, concerning Avro Cadet G-ACHP, three typographical errors occurred. The engine fitted shortly before the war was, of course, a Gipsy *Major*; the aircraft registered G-ABEE was a 1932 Avro Avian; and the airfield at which G-ACHP was lately based was Denham.

AIRCRAFT AND RUBBER

Some Uses for Various Grades

By V. WINSTONE

IN few fields of application are the standards so exacting for the manufacturer and the risk of failure so great as that of aircraft construction. On each of the manufacturers of its components the aircraft industry imposes stringent conditions; and specifications laid down by the Directorate of Technical Development, Ministry of Supply, must be rigidly adhered to. These demands have set the rubber industry, which supplies so many aircraft components, numerous problems.

Parts of modern aircraft must be capable of operating at temperatures as low as −60 deg C, and in extreme cases as low as −75 deg C. As the temperature drops, the characteristics of rubber change. At ordinary temperatures it has very considerable elasticity, whereas at extremely low temperatures it is virtually a rigid material with little or no power of shock absorption. Between these extremes there is an intermediate condition where there is still some deflection and shock absorption, but a very slow recovery.

In the proximity of the powerplants rubber may encounter high temperatures, and considerable heat can also be generated on the external surfaces of aircraft flying at supersonic speeds. In view of such conditions, components must be capable of meeting temperatures as high as 260 deg C and still retain their essential properties.

Not only are the variations of temperature to which aircraft components are exposed great, but these changes are often very rapid, particularly with modern, high-performance military aircraft. Taking an extreme case, such machines can leave a ground ambient temperature of 40 deg C and climb in three minutes to a region where the air temperature is as low as −70 deg C.

Sunlight, which can be very intense in the tropics, also has a well-known adverse effect upon the properties of rubber. Even in temperate zones aircraft operate above cloud for a great deal of their time and so are frequently exposed to the effects of sunlight. A further difficulty is that much of the rubber is in contact with various fluids, such as water, mineral and vegetable oils, antifreeze liquids, petrol and kerosine. It may even be exposed to bare flames.

Modern Materials.—So much for the problems. How does the rubber industry deal with them? The characteristics of natural rubber make it ideally suitable for certain applications. Natural rubber compounds have the merit of retaining their basic properties at low temperatures. They are also preferable for such purposes as the inner linings of certain types of hose, because of their lower volume increase resulting from swelling in vegetable oils. But they have a lower resistance to mineral oils and are more liable to ageing under the effects of bright sunlight, and to ozone cracking, than some of the man-made products available today.

Two synthetics, chloroprene and nitrile copolymers, are being used for their oil- and heat-resistant properties. Chloroprene synthetics are also highly resistant to the effects of ultra-violet light and ozone, and have excellent resistance to most corrosive solutions and a moderate degree of abrasion resistance.

Synthetics of this type, however, are in general more sensitive to low temperatures than is natural rubber, although certain types are being developed which are actually better in this respect. Chloroprene synthetics are frequently used in the manufacture of aircraft components, especially as an outer covering for protection against sunlight and for lining certain types of hose. They are, for example, being used for such purposes as bomb-door seals, and sealing strips round pilots' canopies, doors and windows.

With the introduction of pressurization for high-flying aircraft, inflatable rubber seals made of this material are finding considerable application in sealing gaps in metal-to-metal surfaces round doors and the like, and in places where distortion of the metal might affect air-tightness. The seals are of various extruded forms and are inflated before take-off.

Another use for the chloroprene-type synthetics is for spraying radomes. The latter are made from a special material through which radar signals can pass; unfortunately they are liable to erosion through contact with rain (particularly in high-speed flight), so spraying with synthetic rubber has been introduced to lengthen their life.

Synthetics of the nitrile copolymer type have a high resistance to petroleum-based fuels and lubricants, and to other solvents, and they also possess good ageing and heat-resisting properties.

Sandwiches of this type of rubber synthetic and steel, shaped into strong, compact, vibration-damping brackets are being used to support cabin blowers in some of the latest American airliners. The brackets, mounted on the outboard engine nacelles, are subjected to severe operating conditions; in addition to supporting the 145 lb weight of the superchargers, the brackets must absorb extreme vibration strains developed during landings, take-offs, and engine run-ups.

Another range of synthetics finding increased use in the aircraft industry are the silicones. These remain unaffected throughout a wide temperature range. For example, in the lower ranges of temperature, where the best natural rubber compounds begin to stiffen, silicone rubber shows no stiffening and in certain special grades will remain flexible at temperatures as low as −75 deg C.

Their resistance to heat is another advantage. Special grades of silicone rubber will withstand prolonged exposure to temperatures as high as 200 deg C. They are highly resistant to ultra-violet light and to ozone, and their electrical properties are comparable to other insulating materials at ordinary temperatures, and at high temperatures are superior.

Other synthetics now being used in the aviation field include polyvinyl chloride and butyl rubber, both of which possess a high degree of chemical inertness and ageing resistance, as well as being flame resistant. Butyl rubber is particularly good for its heat-resistant properties, and it also has outstanding resistance to ozone attack. One of its applications is in hydraulic components involving the use of non-inflammable polyester fluid for which natural rubber, chloroprene, silicones and other substitutes are all unsuitable.

Other Uses.—One of the most important applications of rubber to the aircraft industry is in the field of hosing. Apart from the requirements already mentioned, much of the hosing used in aircraft has to work at pressures of 3,000-4,000 lb/sq in with bursting pressure of up to 12,000 lb/sq in. Most of these hoses are of small bore, and wire-braid reinforcing is generally used instead of cotton.

The importance of airframe de-icing has been well demonstrated, and in the past this has mainly been done by using de-icing fluids. At present more attention is being given to rubber heating mats, inside which are embedded electrical heating elements. Some aircraft also use inflatable rubber strips for de-icing the leading edges of the wings and tail.

Among the many small but important uses for rubber in the modern aircraft might be listed flexible crash-proof fuel tanks, made from fabric-covered rubber sheet; cabin heating and refrigeration equipment; corrugated hard-rubber coverings on control handles; natural-rubber bonding strips between the double transparent layers of mist-free windows; and bellows units to seal control levers and braking components.

One application of rubber in aircraft which, though not very apparent, is considerable in scope and importance, is that of adhesives. The problem of securing effective adhesion between rubber and metal in aviation components has been studied exhaustively. Bonding techniques have developed considerably in recent years and it can now be claimed that rubber and most rubber-like plastics can be made to adhere to almost any rigid base. With light-alloy metals, isocyanate or special synthetic-resin adhesives are used most frequently.

Rubber adhesives play their part in attaching de-icing strips to the wings and airscrew blades; in sealing the cabins of high-flying aircraft; and in the construction of fuel tanks, both of the metal and of the rubber "bag" type. In the production of self-sealing tank covers for military aircraft, special rubber adhesives play a vital part in ensuring that the cover acts properly and seals the entry and exit damage caused by projectiles. In civil aircraft, rubber adhesives are used for fixing various fabrics to the fuselage, rubber coverings to cabin floors, and in the construction of upholstery.

Outside the realm of airframes and powerplant in aircraft, a considerable amount of rubber is used in the manufacture of rubber-proofed cloth for such vital items as anti-g suits for combat aircrew, air-sea rescue equipment and so on.

Experiments in rubberizing nylon, terylene and other man-made fibres are taking place, and should lead to the development of waterproof materials of great strength and light weight. A new vapour-permeable cotton cloth which has recently been produced will also offer a useful material for the waterproofing of flying clothing. This cloth, although extremely light, allows water vapour to escape, and thus frees the wearer from the discomfort often associated with waterproof equipment.

—AND CERAMICS

Their Application in Future Aircraft

By W. M. STERRY*

THE aircraft industry is entering a new era, which will be dominated and circumscribed by the thermal barrier and all its related problems. At Mach 2.0, or twice the speed of sound, the temperature of the boundary layer is approximately 450 deg F, at Mach 3.0 it is 800 deg F, at Mach 4.0 it is 1,500 deg F and at Mach 6.0 it will be 3,300 deg F. An experimental rocket powered aircraft, the Bell X-1A, reached a speed of 1,650 m.p.h. in a climb, certain missiles reach Mach 2.5 for short periods during their flight, and several production intercepters are supersonic in level flight. Skin temperatures of 450 to 800 deg F (or possibly higher) are only part of the picture, since the temperatures in the vicinity of the powerplants will be considerably higher. Another source of additional heat will be that generated by the increasingly complex electrical and electronic systems.

It has long been known that the properties of the aluminium alloys at present in use begin to decrease rapidly around 300 deg F, and their use above 400 deg F is out of the question. Titanium alloys appear to offer promise for use up to about 800 deg F or 900 deg F. Certain low-alloy, high-strength steels appear to be competitive in this range and possibly usable up to 1,000 deg F. Above the latter temperature high-alloy steels are usable, but when 1,200 deg F is reached only the so called superalloys are left.

Ceramic Finishes.—One of the most extensive applications for ceramics in aircraft can be protective finishes. In present aircraft one of the common problems can be corrosion. This may be caused by corrosive elements in the surrounding environment, and—when moisture is present—by galvanic corrosion between dissimilar metals. This problem will persist, and in addition there will be the problem of corrosion at elevated temperatures. At present, corrosion protection through the use of organic coatings and various types of electroplating has sufficed. These finishes will be inadequate in most future applications because organic coatings providing continued protection after heating to above 650 deg F are not available; and commonly used electroplates, such as zinc and cadmium, deteriorate after heating to 700 deg F or 800 deg F. Furthermore, electroplating of many of the high-strength steels can produce hydrogen-embrittlement problems. However, ceramic coatings which are inherently heat resistant and which will provide corrosion protection appear to offer considerable promise as protective finishes for certain alloys.

Lower-temperature Coatings.—The alloys requiring coatings at lower temperatures will be the high-strength, low-alloy steels and possibly some of the high-alloy, high-strength steels (which, although similar to 300-series alloys in composition, are somewhat susceptible to corrosion in their heat-treated, high-strength condition). Titanium will not require protective coatings because its alloys are generally as resistant to corrosion as are stainless alloys. Coatings which may be suitable are some of the recently developed low-temperature firing enamels for sheet steels—or perhaps modifications of these enamels. Also, since most of the alloys are used in the heat-treated condition, the firing of the coatings will have to be fitted in with the heat treatment of these alloys. Perhaps investigation of unconventional techniques of application of glassy coatings—such as flame spraying—would produce fruitful results. Fortunately the weatherability or chemical resistivity requirements for these coatings will not be too severe, and can probably be met by the enamels which fire at lower temperatures. The main requirements would be that they be fairly thin, be unaffected by temperatures up to 800 deg F, and that they maintain a discrete protective film for five to ten years. The sections to be coated would be large curved skin sections of varying thicknesses and also a certain number of interior structural members.

High-temperature Coatings.—As well as the previously mentioned relatively low-temperature resistant coatings there will be more extensive applications for ceramic coatings which can provide protection against gaseous corrosion at temperatures of 1,300 deg F to 1,500 deg F in the vicinity of powerplants. Alloys in use in these applications will be stainless types requiring no protection, low-alloy steels (if they can be protected against oxidation) and titanium alloys (if they also can be protected against oxidation and nitrogen embrittlement).

The majority of titanium alloys are susceptible to embrittlement through reaction with nitrogen and oxygen, which starts at 1,000 deg F and becomes more severe at increasingly elevated temperatures. The sensitivity to these reactions varies with the particular alloy but, generally, all the titanium alloys are seriously embrittled if exposed to temperatures over 1,200 deg F for any appreciable length of time. Preliminary work has shown that ceramic coatings will provide protection sufficient markedly to prolong the life of the component; alternatively the coating will permit the use of a component at a temperature which would destroy an uncoated one. Although development of coatings for titanium alloys will require considerable preliminary work, the task will be eased by the fact that typical sheet-steel enamels can be applied to titanium alloys quite readily. The 1,300 deg F to 1,500 deg F service range previously mentioned for non-structural titanium components is felt to be realistic at present. However, it should be pointed out that the development of titanium alloys is progressing very rapidly and, although none of the presently available alloys have satisfactory strengths for use as structural components above 1,000 deg F, it is possible that future alloys will have satisfactory strength/weight ratios for use at temperatures up to 1,500 deg F, and perhaps higher.

Aluminium and Magnesium.—Ceramic coatings can be considered as protective finishes for aluminium and magnesium, although these alloys will probably be little used because of their low strength/weight ratio above 500 deg F. However, they may be used in small amounts for non-structural components, and if a protective finish resistant to temperature is required ceramic coatings should be satisfactory.

Ceramic Hard Coatings.—Certain ceramic coatings may be satisfactory for use as abrasion-resistant hard coatings for use at elevated temperatures. Some of the presently used electroplated hard coatings, such as hard chrome plate, will be unsatisfactory because of their decrease in hardness at the elevated temperatures which have been discussed. Possibilities are the very new flame-sprayed pure oxide coatings, more conventional abrasion-resistant porcelain enamels, temperature-resistant refractory ceramic coatings, and finally cermet coatings applied by enamelling techniques or flame-spraying.

Insulating Coatings.—Refractory thermally insulating coatings which could be conveniently applied to various odd-shaped aircraft components are also of interest. At present various types of insulation, such as fibreglass, are wrapped around ducts and equipment in the forms of batts. The manner in which the batts are held in place is not always satisfactory, and placement of the right amount of insulating coatings which would by themselves adhere to the parts and which would not be destroyed by high-intensity vibration, would be of considerable value.

Ceramic Markings.—Another potential use of ceramic coatings will be as ceramic markings on future aircraft. Large aircraft have literally hundreds of small and large markings on the exterior and interior pertaining to the location and maintenance of various items of equipment. At present these markings are painted on, or consist of small painted—or, occasionally, engraved—nameplates riveted to the part. Organic markings will be unsatisfactory for use at elevated temperatures, yet porcelain-enamel markings should be satisfactory since they can be chosen for temperature resistance and conformity with colour codes. Techniques of application could consist of enamel markings applied to nameplates which could then be affixed to the part. This procedure has already been used with success on some of our present aircraft. Also ceramic decals [transfers] might be applied to parts and then fired with a torch. Flame-spraying through stencils might also produce worthwhile results.

Ceramic Lubricants.—Speaking more generally, we have found that in an industry as new and yet as complex as the aircraft industry there are many places where ceramic materials can be used to advantage in ways unfamiliar to the ceramist who developed the original material or process. An example is the use of molten glasses as lubricants to be used at elevated temperatures. Forming at temperatures of 800 deg F and higher is necessary with some of the newer high-strength titanium alloys. Such temperatures prevent the use of conventional forming lubricants. Molten glasses are being evaluated as lubricants and we have obtained some very encouraging results using commercially available enamel glasses which can be readily removed after the forming operations. There are indications that these glasses, when applied to the whole blank, will also inhibit scale formation.

Continued overleaf

**Boeing Airplane Company, Seattle, Washington.*

AIRCRAFT AND CERAMICS . . .

Protective Coatings for Use During Heat Treatment.—Another processing problem of titanium alloys is their protection from embrittlement during heat treatment. The use of reducing atmospheres during heat treatment, as in the case of steels, is not satisfactory, because at elevated temperatures titanium is also embrittled by nitrogen and hydrogen. Vacuum, or inert-gas atmosphere, furnaces would prevent embrittlement, but their use would be expensive and awkward for production processing. Therefore, we are currently investigating the use of ceramic coatings which will protect the titanium during heat treatment, and it has been found that certain coatings provide satisfactory protection up to 1,650 deg F for half an hour. These coatings are readily removed after heat treatment of the parts.

High-temperature Jigs and Fixtures.—Considering the number of elevated-temperature processing operations required in the fabrication of the various alloys to be used in the future it is apparent that there will be a need for jigs, fixtures, and dies which will be resistant to elevated temperatures. Refractory jigs and fixtures will be satisfactory for many applications, but there will be others where high-temperature ceramic coatings will allow the use of metal fixtures. There are available an increasing number of cast irons and wrought alloys with satisfactory strength at elevated temperatures but requiring protection against oxidation.

Ceramic Adhesives.—Somewhat removed from enamelling, but certainly of interest to frit manufacturers, is the possible use of enamel glasses as elevated-temperature resistant adhesives. We began to study this possibility when it became evident that organic adhesives would be unsatisfactory for use in future "high-temperature" aircraft. The first alternative is brazing and this is currently under study by a number of companies. Since the brazing operations take place at 1,900 deg F to 2,000 deg F many problems (such as atmosphere control in large furnaces, jig and fixture materials, control of time at temperature for complex assemblies and subsequent heat treatment of the assemblies) remain to be overcome. In attempting to develop satisfactory ceramic adhesives we felt that the disadvantage of a brittle ceramic bond might be outweighed by the advantages of lower processing temperatures, less critical atmosphere control and the readily controllable working properties of molten glasses. We have obtained some promising results.

THE INDUSTRY

Avro Personnel Appointment

APPOINTED personnel manager of A. V. Roe and Co., Ltd., is Mr. John Gee, who joins them in advance of the impending retirement of Mr. Frank Greenhalgh, labour superintendent, who has been with the company for some 40 years. Mr. Gee, who for the past three-and-a-half years has been personnel manager of Platts (Barton), Ltd., is no stranger to Avro products, for he flew Lancasters in No. 153 Sqn., Bomber Command, during the war. He completed more than sixty operational sorties and was awarded a D.F.C. and Bar.

Mr. John Gee.

Sales Manager at Vintens

S/L. Munro.

ON his retirement from the active list, S/L. D. J. ("Don") Munro has taken up an appointment with W. Vinten, Ltd. (manufacturers of ciné cameras and associated equipment), as sales manager. For the whole of his 36 years' service with the Royal Air Force S/L. Munro has been associated with photography. He has first-hand experience of all aspects of the problems involved in photographic reconnaissance in the air and pictorial production on the ground, both at home and overseas. After serving as a photographic instructor at a number of Service schools, he was selected for service with the Ministry of Supply, R.D. Photos, and subsequently with A.C.A.S.(O.R.), Air Ministry, where he was concerned with photographic operational requirements.

S.B.A.C. Materials Data

THE Society of British Aircraft Constructors has prepared a second issue of *S.B.A.C. Materials Data Sheet MAT. 1—Schedule of Steel Bars and Forgings.* Amended in detail, it introduces chromium-molybdenum S.106 and chromium-molybdenum-vanadium D.T.D.730 (primarily nitriding specifications), into the general alloys category in order to draw attention to the usefulness of these alloys, particularly when nickel is in short supply.

The *Materials Data Sheets* provide a key to the B.S. and D.T.D. material specifications currently used by the industry, with information on mechanical properties and—a particularly useful feature—a reference to the specifications which they replace.

The range of data sheets at present available is: *MAT. 1, Steel bars and forgings; MAT. 2, Aluminium Alloy Sheet and Strip; MAT. 3, Aluminium Alloy Castings; MAT. 4, Aluminium Alloy Bars, Forgings and Extruded Sections; MAT. 5, Aluminium Alloy Tubes.*

Copies may be obtained from the offices of the Society at 29 King Street, St. James's, London, S.W.1., price 1s each sheet or 5s the set of five.

IN BRIEF

A member of the Board of High Duty Alloys, Ltd., since 1951, Mr. Gilbert Hunt has been appointed general manager.

* * *

Bakelite, Ltd., announce the appointment of Mr. R. Hart Still to the Board, and of Mr. A. J. Hearn as chief accountant.

* * *

Mr. J. Hanford Stevens, Assistant Secretary (Aircraft Production) of the Australian Department of Defence Production, has resigned from Government service in order to join the Firth Cleveland Group as managing director of their Australian subsidiary, Simmonds Aerocessories Pty., Ltd., of Ballarat, Victoria.

This Model 9 Mk 12 9in landing lamp by Harley Aircraft Landing Lamps, of St. Neots, Hunts, gives a powerful beam with a wide, diffused spread at the edges. Extension is by means of a Plessey electric actuator. A lamp of this type is fitted on the Short Seamew.

A permanent exhibition by member-firms is to be opened on February 9th by the Scientific Instrument Manufacturers' Association at their headquarters at 20 Queen Anne Street, London, W.1.

* * *

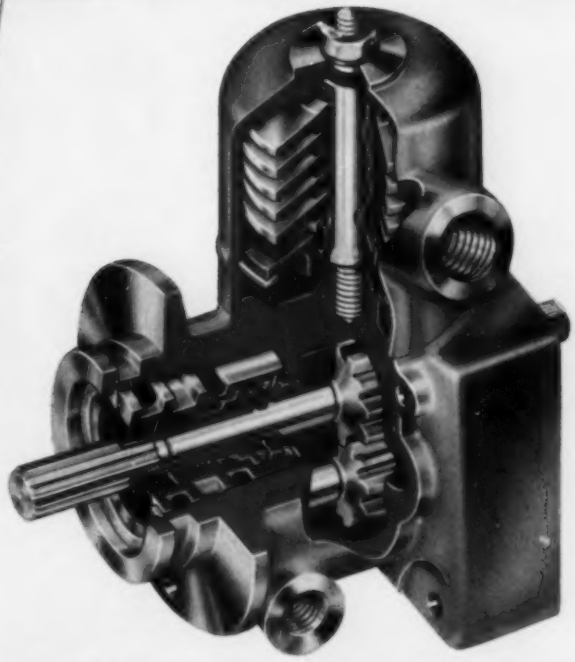
Mr. T. R. Hardman has been appointed general manager of Tecalemit, Ltd., lubrication equipment manufacturers of Plymouth and Brentford. Now 43 years of age, Mr. Hardman joined the Tecalemit Brentford works in 1941 as a draughtsman. He became chief draughtsman in 1946, and was later made assistant to the technical director.

* * *

Samuel Fox and Co., Ltd., announce two new appointments. Mr. C. M. Slocombe has been elected to the Board, and Mr. A. C. Brierley, at present in the United Steel Companies' export department, has been appointed to succeed Mr. J. H. Goodlad as sales manager for light steel.

aircraft pumps by Plessey

This is the main fuel pump for a small gas turbine. It is a positive displacement type, with a built-in filter and having a Duplex seal on the input shaft, with independently vented gland chamber to prevent any possibility of dilution of the engine oil with fuel. Pressure-loaded bearings ensure high volumetric efficiency under all operating conditions, not only when the pump is new, but also after prolonged service, because of the automatic adjustment for any slight wear that may take place. Special means of lubricating and cooling the bearings ensure that the pump is not liable to damage by dirty fuel. The particular unit illustrated provides a shaft drive for the fuel system governor which mounts directly on the pump end—and provides an outstanding example of the way in which Plessey will produce special pumps to meet any reasonable requirement.



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A 10ft increase in span, coupled with a revised trailing edge, gives the Boeing Intercontinental (right) 500 sq ft more wing area than the standard Boeing 707-120. Boeing claim that even the heaviest of the three versions described below will have "take-off and landing characteristics at least equal to those of any long-range transport aircraft."

CIVIL AVIATION

VISCOUNT SCORE NOW 274

FORMATION of a new airline company, Air Austria Luftfahrts, on January 11th, was followed two days later by the announcement of their order for four Viscount V.803s of the type already ordered by K.L.M. The Dutch airline, incidentally, is reported to have a 29 per cent holding in Air Austria, and, it is believed, will make available DC-4s for their initial operations.

The Austrian order brings the total number of Viscounts now sold to 274 and the number of airline customers to 24; three governments and three private companies have also bought Viscounts. Until recently, the largest number of Viscounts ordered by a single operator was 60. The latest repeat orders placed by B.E.A., however, increase to 65 the total number of Viscounts bought by the Corporation. Of this total, 26 aircraft —all V.701s—have been delivered. One more V.701 is on order, and B.E.A. have also signed contracts for 24 V.802s and 14 V.806s. Powered by 2,100-e.h.p. Dart R.Da.7s, the V.806 will have a cruising speed of 363 m.p.h.; the first is due for delivery in the autumn of 1957. In addition, B.E.A. have also ordered 20 Tyne-powered V.901 Vanguards for delivery in 1959-60.

DECCA AS AN EMERGENCY AID

IT now seems to have been established beyond doubt that water contamination of the fuel was responsible for the emergency landing of B.E.A. Viscount G-ANHF at Cazaux, Bordeaux, on January 2nd. The aircraft, it will be recalled, was safely landed by Capt. E. R. Watts with one engine—No. 3—giving full power, and with only occasional bursts of power from the other three. The Corporation is now completing its inquiry into the cause of the fuel contamination.

In reporting on the emergency landing, Capt. Watts paid this remarkable tribute to the Viscount's Decca navigational aid: —

"During the incident on January 2nd I was fortunate enough to have a Decca Navigator on my machine. I say fortunate, for although I had a very competent crew the additional advantage of having a visual check on my position was invaluable. When the trouble developed I set course for Bordeaux purely on Decca, later checking by beacon and bearings. We were flying over eight-eighths cloud during most of the descent and at one stage I was told I had actually crossed the coast. I glanced at Decca, which gave me a position some 35 km from the coast; I decided to believe this and continued to hold as much height as was possible. Some seconds later we broke cloud over the sea, thus proving Decca to be right. I was very happy indeed to have had the additional crew member along with me, namely Decca."

FIRST TO SOUTH AMERICA

IT would have been a pity if the tenth anniversary of the first official flight from London Airport, or Heathrow as it was called in those days, had passed unnoticed. It was on New Year's Day, 1946, that Lancastrian *Star Light* of the newly formed but short-lived British South American Airways took off on a proving flight to Argentina, and the occasion was recalled at a small dinner at Londonderry House on January 9th. The host was A.V-M. D. C. T. Bennett, then B.S.A.A.'s managing director and captain of *Star Light* on the historic flight. The guests of the air vice-marshal (who, to many people's regret, is no longer "in aviation") included H.E. Dr. Alberto Candioti, the Argentine Ambassador; Lord Winster, the first post-war Minister of Civil Aviation, who was instrumental in the formation of B.E.A., B.O.A.C. and B.S.A.A.; Mr. Ivor Bulmer-Thomas, former Parliamentary Secretary, M.C.A.; Captains R. C. Alabaster and D. A. Cracknell, respectively co-pilot and navigator of *Star Light*, both of whom are now with B.O.A.C.; and G/C. C. F. Sarsby, then technical manager of B.S.A.A., now at the Ministry of Supply.

C.A.A. CONTROVERSY CONTINUES

THE former head of the U.S. Civil Aeronautics Administration, Mr. Fred B. Lee, told an aviation subcommittee of the Senate Commerce Committee recently that his resignation was not a voluntary act. Mr. Lee, who was succeeded on December 9th by the deputy administrator, Mr. Charles J. Lowen, claimed that he was unable to obtain specific reasons for the request that he should resign, which was originally made on October 17th, and repeated on November 29th, by Mr. Louis S. Rothschild, Under Secretary of Commerce. In a statement issued on December 12th, Mr. Rothschild said that "the decision was reluctantly made that someone better suited in leadership talent and teamwork was required."

The chairman of the subcommittee, Sen. M. Monroney, is sponsoring a bill which would divorce the C.A.A. from the Department of Commerce and re-establish it as a separate agency. According to the *Aviation Week*, the subcommittee will investigate "charges that C.A.A. has not kept abreast of vast technical advancements in aviation, with a result of near-chaos in air traffic control." In recent months the C.A.A. has been strongly criticized, the journal adds, for its "failure to meet the growing crisis on the nation's airways."

THREE OF A KIND

EXISTENCE of three versions of the Boeing 707, together comprising a "jet transport family," was officially confirmed last Sunday in a statement by the manufacturer's director of sales, Mr. Ralph S. Bell. The essential aerodynamic features of all versions, he said, were being thoroughly proved in the prototype 707, which now had more than 360 hr flying to its credit.

The "standard" Jet Stratoliner has the designation 707-120. This type is powered by J57 turbojets and has been ordered by Pan American Airways, American Airlines and Continental Air Lines. Next comes the 707-220, ordered by Braniff Airways, which is of similar dimensions but will be powered by an "advanced P. and W. turbojet." Finally, there is the 707-320 Intercontinental (illustrated above), as ordered by PanAm, Air France and Sabena; this is a larger aircraft intended for stages of more than 5,000 miles with full payload and reserves.

Boeing claim that the 707-320 will be capable of achieving the following block times: Chicago to Paris non-stop, 7 hr; New York to Rome non-stop, 7½ hr; London to Johannesburg non-stop, 10 hr 48 min; London to Sydney *via* Cairo and Calcutta, 21 hr 7 min. Power-units of the Intercontinentals on order will be the P. and W. JT4, but Boeings say that "new English turbojets now under development" may also be used. Leading particulars of the 707-120 and the 707-320 are summarized below: —

	120	320
Length	134ft 6in	146ft 8in
Span	130ft 10in	141ft 6in
Height	38ft 3in	38ft 11in
Wing area (sq ft)	2,400	2,900
Gross weight (lb)	240,000	295,000
Passenger capacity (tourist)	125	146
Fuel capacity (U.S. gal) ...	17,400	21,200
Cruising speed (m.p.h.) ...	550-575	550-600

First deliveries of the three versions are due in December 1958 (707-120), August 1959 (707-320) and October 1959 (707-220).

AQUILA'S NEW SERVICE INAUGURATED

A "RUSH of bookings" is reported to have resulted from extensive television coverage of Aquila Airways' new 1,600-mile fortnightly service from Southampton to Las Palmas, capital of Gran Canaria. Departing on January 8th, the service was

Representing the last stage in a long "stretch," the Douglas DC-7C (left) is compared here with its immediate predecessor, the DC-7B; the latter, incidentally, is one of 40 "Golden Falcons" ordered by Eastern Air Lines. The Seven Seas has a length of 112ft 3in, 3ft 4in more than the DC-7B, and span has increased by 10ft to 127ft 6in; the new fin, taller by 2ft 2in, gives it a height of 30ft 9in. DC-7Cs now on order total 104.

CIVIL AVIATION . . .

inaugurated by Aquila's latest 48-seat Short Solent 4, G-AOBL *Aotearoa*, recently purchased from Tasman Empire Airways of New Zealand. R.M.A. *Aotearoa* was named by H.M. the Queen when originally launched at Belfast and was later used by Her Majesty to visit Tonga and Fiji from New Zealand during her Australasian tour.

For the inaugural flight, *Aotearoa* was commanded by Capt. James Broadbent, who still holds the Australian-England solo speed record, which he established in 1938 with a Vega Gull in 5 days, 4 hours. Broadbent, who is 45, has been flying for 27 years. He is now entering his 21st year of flying-boat service—a record believed to be unsurpassed. Broadbent has also flown Freighters for Silver City, a sister company of Aquila in the British Aviation Services Group.

Late rail connection and adverse winds (reports one of the 30 outbound passengers) delayed departure from 2030 hr to 2130, but the torch-lit flarepath at Lisbon was reached in four and a half hours at 0200.

The aircraft is refuelled at Lisbon to enable a quick turn-round to be effected at Las Palmas, and crews are slipped. The new crew takes the aircraft to Las Palmas and returns it to Lisbon, and the slipped crew take over again for the final leg to Southampton.

Take-off from Lisbon is at 0420 and arrival in Las Palmas 0840. At Lisbon passengers disembarked by launch for a snack in the flying-boat terminal while the Solent refuelled from a motor tanker on the Tagus. A launch was also used at Las Palmas, where the aircraft moored to a buoy in the picturesque harbour. Thus the outward trip occupied 11 hr 10 min, of which 8 hr 50 min was spent in the air.

After a Canary Island sojourn of 2 hr 40 min (during which one learned, incidentally, that flats could be rented for £1 per month) the machine left at 1120 for Lisbon. Commander of the slip crew on the inaugural flight was Capt. J. N. Leedham.

Six of the outward passengers had hoped to become the world's first day trippers from Britain to the Canaries, but on arrival at Lisbon at 1600 we learned that blizzards in England suggested that a night out in the Portuguese capital would be more enjoyable.

The Lisbon-Southampton leg was completed next day in perfect weather in 4 hr 40 min. So the total flying time for 3,280 miles was 17 hr 50 min—an average speed of almost 190 m.p.h. despite 45-m.p.h. headwinds on most of the homeward flight. Throughout the trip the Solent cruised at an airspeed of 230 m.p.h.

ORDER-BOOK AMENDMENTS

AN order for 14 Convair 440 Metropolitans was announced by Braniff Airways too late for inclusion in the "order-book" feature published on page 61 of last week's issue. Two more 440s are reported to have been ordered by Alitalia, bringing the total number of Metropolitans sold to 81.

As several readers were quick to point out, we over-stated the number of L.1649As sold by Lockheed; the Air France order is for 12, not 20, of these aircraft, and the total sold to date is thus 36. The Electra "box-score" did not include the order announced a few days previously by National Airlines for 20, increasing total Electra sales to 104.

BREVITIES

PLANS for a fast new Qantas Constellation service between Sydney and London are reported from Australia. To be known as the Connoisseur Express, the service is due to begin on March 2nd. Operating once weekly, it will reduce present schedules by more than 20 hours, taking 52 hr eastbound and 54 hr westbound.

* * *

Captain A. L. Greenacre, chief pilot of West African Airways Corporation, will be responsible for operating arrangements of all W.A.A.C. aircraft on H.M. the Queen's forthcoming West African tour. As advisory commander to the Royal Flight, he will travel on the flight deck of the aircraft used by the Queen during the tour.

* * *

Lufthansa announce the appointment of Mr. Peter R. Easton as their Press and public relations officer in the United Kingdom. He will be based in the airline's London office at Empire House, 117/119 Regent Street, London, W.1 (Regent 1501).

* * *

Experimental forms of marking and lighting—consisting of chequer-board lighting, stub-bar board and lights, angle-of-approach indicators and a daylight cross-bar—have been installed on Runway 08 at Blackbushe. Details are given by M.T.C.A. in *Civil Aviation Information Circular* No. 136.

* * *

Following B.O.A.C.'s acceptance of the first two Bristol Britannia 100s, the appointment has been announced of Mr. E. J. Curwood as fleet engineering manager, Britannias. He is succeeded as fleet engineering manager, Stratocruisers, by Mr. S. R. Peek, formerly base engineer, Constellations.

* * *

Delivery of the three 16-seat de Havilland Herons ordered by Cambrian Airways is due to begin in March, and the airline plans to introduce its new aircraft to regular service on April 1st. They will be operated initially on the network of routes linking Cardiff, Bristol and Southampton with Nice, Paris and Dinard.

* * *

At a conference of American airport operators, held in Washington on January 12, a Douglas spokesman predicted that future jet airliners would definitely have a higher noise level than that of present transports. This, he said, might come as a blow to airport operators; but though manufacturers had made inroads on the problem, and had arrived at a solution which would definitely bring about a reduction in jet noise, the level would still be higher than for today's aircraft.

* * *

The general sales manager of B.O.A.C., Mr. Gilbert Lee, was due to leave London yesterday on a 32-day world tour. During the tour Mr. Lee will preside at sales conferences in Hong Kong and New York and will discuss sales matters with Corporation staff at several other stations overseas.

* * *

Inauguration of a non-stop Super Constellation service between New York and Montego Bay is announced by Avianca, the Colombian affiliate of Pan American.

* * *

Provisional approval for the operation of a regular service between Yeadon Airport, Leeds, and London Airport has been granted to B.K.S. Air Transport, Ltd. The service, which is expected to begin in May, will initially be operated at a frequency of three return flights daily; approval has also been given for a service between Yeadon and Glasgow.

* * *

The five Ansons operated by MacRobertson Miller Airlines of Western Australia are being replaced by Doves and will shortly be sold; difficulty in obtaining Anson spares, now that the type is no longer in production, is the main reason for the decision. The first of M.M.A.'s Ansons entered service in October 1946 and now has more than 7,000 hours of civil flying to its credit.

* * *

Construction has begun of a "staff colony" for 600 employees of Air-India International and Indian Airlines Corporation and members of their families. Situated near the Air-India maintenance base at Santa Cruz Airport, Bombay, the colony covers a 20-acre site and will include 26 buildings, containing living quarters, a school, playground and shops; it is due for completion at the end of 1956.

Marconi Multi-Channel VHF Aircraft Communication Equipment

TYPE AD 115

The type AD 115 equipment is a remotely controlled transmitter/receiver which provides:

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- Transmission and reception on same or different frequencies.

Features include

- Direct reading frequency scales on the controller to ensure rapid channel selection.
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- Special crystal economiser circuits which enable 24 crystals to provide 140 channels.
- Efficient squelch circuit to eliminate receiver noise when no signal is received.
- Full metering facilities for stage checks to enable rapid servicing.
- Accessibility of sub-assemblies.

The equipment consists of main transmitter/receiver unit and one of two types of controller unit, according to the method of operation. The main unit (left) is built up of receiver, drive, transmitter and power sub units. On the controller unit (right) the required channel is selected by the operation of two switches which actuate an automatic switching device.

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CLUB AND GLIDING NEWS

ELSTREE Flying Club flew a total of 3,180 hr during 1955, an increase of 571 hr over 1954 and a figure deemed worthy of a party at the clubhouse on Saturday last. Over a half-pint, C.F.I. David Ogilvy disclosed two recent activities: a session of Auster-flying over portable, wheeled, film-company-type trees for the benefit of Borehamwood Studio cameramen; and his recent appointment as assistant public relations officer to the Festiniog Railway, a vintage organization whose machines have an undercarriage track of only 1ft 11½in. Newly appointed to the committee of the club are Peter Heywood, Paul Boucher and Cedric Vernon, together with Dr. L. M. Henry (representing the interests of the private owners).

MEMBERSHIP of the Kronfeld Club, founded only a few months ago to encourage and popularize gliding and light-aircraft flying, is now approximately 150. First of the club's 1956 functions was a film show presented by Lawrence Wright on January 4th; this comprised a German training film on meteorology, films of the 1954 World Gliding Championships at Camphill and the 1955 National Contests at Lasham, and one ("All the King's Horsas") showing the development of R.A.F. glider units during the war. The following Wednesday, January 11th, a full house (or rather basement) heard Mr. F. N. Slingsby talk on Slingsby designs, from the first to the 42nd and latest. His descriptions of these types were followed, in almost every case, by the wry comment: "Well, that one didn't pay. . . ."

The club still has room for more members, who are (1) required to be keen on light aviation, (2) encouraged to patronize the bar and/or Espresso coffee bar, (3) invited to attend the Wednesday-evening talks and film shows, and (4) urged to assist in putting the final touches to the redecoration of the club premises. The address is 74 Eccleston Square, London, S.W.1, and at present the club is open from 6 to 11 p.m., from Monday to Friday.

REPORTS from Australia and Canada indicate that amateur construction of ultra-light aircraft is to be encouraged in both countries.

A spokesman for the Australian Department of Civil Aviation stated recently that legislation would be passed through Federal Parliament during 1956 to permit those with pilots' licences to build and fly approved ultra-light designs. Approval would be given for construction-kit designs which had been accepted by airworthiness authorities in the country of origin (examples of American, British and French types were quoted). It was expected that kits for the machines, which must not exceed 1,200 lb weight, 75 h.p. engine power or 45 m.p.h. stalling speed, would sell at £A300-1,000.

In Canada, tentative regulations have been drafted to ease the requirements for a flying permit for amateur-built ultra-lights. One type-permit has been issued for an American-designed constructional kit, and the Department of Transport plans to study the results of this step before issuing more. As was the case in Britain prior to the 1955 ultra-light airworthiness requirements, amateur-built aircraft are not banned in Canada, but government requirements for a C. of A. have been so stringent that it was difficult for amateur constructors to comply with them. Under the proposed new regulations, the operation of amateur-built machines would be limited: flying would have to be carried out in daylight and within a radius of 25 miles; no passengers could be carried; and flights would not be permitted over thickly populated areas.

THE Hogmanay dinner-dance of the Strathtay Aero Club was much enjoyed by all concerned, secretary Andrew MacKay reports, and the club film nights are proving very popular. Flying was possible on only 19 days during December, in spite of which the creditable total of 62 hr was flown—almost double the figure for December 1954.

DURING the first seven months of the Lancashire Aero Club's financial year (i.e., the last seven months of 1955), members logged a record total of 877 flying hours. The club's annual supper dance is to be held on February 24th at the Mere Country Club. Dawn patrols by the club are now regularly flown from Barton to Blackpool, Liverpool, Leeds or Coventry on Sunday mornings—"dawn" being widely interpreted to accommodate a 10 a.m. take-off.

THE annual dinner of the Association of British Aero Clubs and Centres will be held at the Waldorf Hotel, London, on Friday, February 17th, at 7 p.m. for 7.30. Admission to the dinner is restricted to men only; tickets, price 25s, may be obtained either through member clubs or from the Association at 7c Lower Belgrave Street, London, W.1.

RECENT news from the Orkney Popular Flying Group—the most northerly club or group in the United Kingdom—is of good progress. Since the reorganization of the Orkney Flying Club as the Orkney P.F.G. (a co-ownership group affiliated to the Popular Flying Association) in February of last year, the group's first P.P.L. has been gained by one member and two others have made first solos. This small but active group operates with no full-time paid staff, all instructional and clerical work being undertaken voluntarily and in spare time. There are now three private aircraft in the county of Orkney (population 21,000); the group's Tiger Moth, and two Austers, both owned by members.

R.Ae.C. PILOTS' CERTIFICATES, OCTOBER-DECEMBER 1955

No.	Name	Cl.	Date	No.	Name	Cl.	Date
28,713	G. S. Murray	1	4/10/55	28,721	C. G. Davis	1	27/10/55
26,714	P. L. Havenden	3	5/10/55	28,722	W. R. F. Cooney	3	27/10/55
28,715	H. Knight	2	10/10/55	28,723	P. Tozer	3	7/11/55
28,716	J. E. Leech	3	13/10/55	28,724	R. W. Mills	3	30/11/55
28,717	P. J. E. Hodgkinson	4	13/10/55	28,725	G. R. Coy	2	1/12/55
				28,726	J. F. Garton	1	5/12/55
28,718	Miss J. L. Ferguson	3	14/10/55	28,727	C. G. Claydon	4	13/12/55
				28,728	P. J. Oake	3	16/12/55
28,719	B. J. A. Schauer	3	21/10/55	28,729	B. A. Clarke	4	19/12/55
				28,730	C. J. Greenough	3	19/12/55
28,720	E. H. J. Thornton	1	26/10/55	28,731	G. Mackrell	2	22/12/55

GLIDING enthusiasts in the county of Kent are now taking active steps to re-form the Kent Gliding Club, originally founded in 1930 but which has remained inactive since the beginning of the war in 1939. It appears that there is interest in the project both from new recruits to gliding and from experienced pilots living in Kent and now flying at clubs elsewhere. It is hoped that Detling will be the new club's site: application for Air Ministry permission to use the airfield has already been made. Those interested—experienced pilots in particular—are asked to contact Mr. H. D. Gardiner, 1 Devon Gardens, Birchington, Kent (Thanet 41453).

DEFINITE dates for the 1956 World Gliding Championships at St. Yan, France, have now been announced. Practice flying will take place from June 23rd to 28th; opening ceremony, June 29th; competition flying, June 30th to July 12th; and prize-giving ceremony July 13th. Entries from each country will consist of a maximum of two single-seaters and two two-seaters, or three single-seaters and one two-seater. If more than 60 aircraft are entered, however, the number of entries will be reduced.

The British team, it is expected, will comprise Philip Wills, Geoffrey Stephenson and Nick Goodhart (single-seaters) and Tony Deane-Drummond and another pilot (two-seater).

THIS year's Gliding Ball, organized by the British Gliding Association, will take place on Friday, March 16th, from 8.30 p.m. to 2 a.m. Tickets, price £1 (including buffet supper) are obtainable from the B.G.A. at Londonderry House, 19 Park Lane, London, W.1; all profits will go towards financing the British team in this year's world championships. As in previous years, the instructors' conference and the annual general meeting of the Association will be held on the following day.

FORTHCOMING EVENTS

Jan. 20. **Institute of Navigation:** Some Meteorological Aspects of High-Level Navigation—(1) "Jet Streams in Flight," by Capt. B. C. Frost (B.O.A.C.); (2) "Forecasting Jet Streams," by J. K. Bannon and T. H. Kirk (Meteorological Office).

Jan. 21. **Aircraft Recognition Society:** Ninth All-England Recognition Contest.

Jan. 24. **R.Ae.S.:** Section Lecture: "Low Consumption Jet Engines," by A. A. Lombard, F.R.Ae.S.

Jan. 27. **S.L.A.E. (London):** Discussion "Responsibilities and Problems of Flight Engineers."

Jan. 31. **R.Ae.S.:** Graduates and Students Section: "Laminar Flow Aircraft Design," by J. B. Edwards.

Feb. 2. **R.Ae.S.:** Section Lecture: "New Ideas in Plastics for Aircraft Structures," by J. E. Gordon, B.Sc.

Feb. 7. **Institute of Transport:** Informal Luncheon.

Feb. 8. **Air-Britain:** "The Conquest of Space in the Light of New Developments," by P. Moore.

Feb. 9. **R.Ae.S.:** Section Lecture: "Propellers for Military and Civil Aircraft," by L. G. Fairhurst, M.I.Mech.E., F.R.Ae.S.

Feb. 10. **Helicopter Association:** "Engineering Aspects of Helicopter Bus Operations in City Centres." Three papers introduced by J. S. Shapiro, Dip.Ing., A.F.R.Ae.S. (at 5.30 p.m.).

R.Ae.S. Branch Fixtures (to January 26th):—

Jan. 20, *Birmingham*, President's Night; *Leicester*, Annual General Meeting and Film Show. Jan. 24, *Bristol*, "Aeroelastic Problems in Connection with High-speed Flight," by E. G. Broadbent; *Belfast*, "The Turbulent Atmosphere," by E. Hyde. Jan. 26, *Yeovil*, Patents Brains Trust. Jan. 26, *Isle of Wight*, "Interplanetary Flight," by A. V. Cleaver.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Changes at Cranwell

A NUMBER of changes are to be introduced this year into the flying training and other instruction given to pilots and navigators at the R.A.F. College, Cranwell. Changes are also being made in the method and frequency of entry. The alterations have been decided upon by the Air Council so that the College may the better fulfil its task of training officers, not only as highly qualified pilots, but also as leaders fitted in due course to hold the highest posts in the Service.

Cadets from now on will complete their flying training on jet aircraft at the College. The College airfield runways have been extended to permit operation of Vampire T.11 trainers, and the Cranwell flying training syllabus now falls into line with that of the other R.A.F. flying training schools. Hitherto Cranwell cadets have taken their jet flying course after leaving the College. The length of the College course is being increased from eight terms, lasting two years eight months, to nine terms, lasting three years. The object of this is to achieve the standard of education which is essential in these days of more complex aircraft and equipment at the same time as providing additional time for flying training on jets during the College course. There will be two instead of three entries each year. In 1956 these will be in January and September. Students will be officer-cadets from the date of entering Cranwell instead of as hitherto holding airman status for the first two terms. This will enable the new entrant to concentrate his energy and interest on a more progressive educational syllabus and on officer training from the start.

After the January 1956 entry the minimum educational standard for all candidates will be that of the Civil Service Commissioners' examination, which is broadly equivalent to that reached at the end of the first year in a 6th Form. This aim is to achieve a greater uniformity of education background among the cadets, resulting in a general raising of the standard of education reached at the College. Hitherto A.T.C. cadets and members of a R.A.F. section of the Combined Cadet Force holding a Proficiency Certificate have been admitted to Cranwell with somewhat lower educational qualifications. The Air Ministry Selection Board will, however, take into account a boy's service in the A.T.C. or the C.C.F. and particularly the holding of a Proficiency Certificate in awarding places at Cranwell.

All pilot and navigator cadets will receive training in basic navigation—including some 60 hours' flying—during their first year. This training will be done in Marathon and Valetta aircraft. In the second year pilots will pass on to the Provost-Vampire flying training, and navigators will embark on their advanced navigation training.

Atomic Weapons Task Force

THE Air Task Force for the third series of British atomic tests in the Monte Bello Islands is being formed under the command of G/C. S. W. B. Menaul, D.F.C., A.F.C. More than twenty aircraft of the R.A.F. and several from the Royal Australian Air Force will form part of the Force which will operate from Pearce Field, Western Australia, and Onslow, North-Western Australia. Canberras operating from Pearce Field will be employed in collecting and delivering cloud samples, and also in a variety of photographic tasks. Varsities and Whirlwind helicopters will carry out other tasks including low-level radiological surveys, vertical photography over the explosion area and air communication between the mainland and the Monte Bello islands. Neptunes of the R.A.A.F. will be flying area safety patrols, watching for surface shipping and ensuring that none is in the danger area at the time of the detonations. From mid-February four Shackletons of Coastal Command will fly daily over the Timor Sea from Darwin. They will be on the look-out for tropical storms known as "willy-willies."

While the R.A.F. element of the Air Task Force will be mainly self-supporting the fullest facilities have been offered by the R.A.A.F. at its bases in Australia. W/C. P. F. Raw, D.F.C., A.F.C., R.A.A.F., and other R.A.A.F. officers will serve on G/C. Menaul's staff

No. 84 Squadron Standard

ON January 5th, Air Chief Marshal Sir Francis Fogarty, K.C.B., K.B.E., D.F.C. (Air Council Member for Personnel), presented the Standard to No. 84 Squadron at R.A.F. Station Abu Sueir. Sir Francis, who commanded No. 84 Squadron in 1935-37, is engaged on a tour of the Middle and Far East Air Forces. Two other former squadron commanders now stationed in M.E.A.F. were also present—A.V-M. D. H. F. Barnett, C.B., C.B.E., D.F.C. (A.O.C., No. 205 Group), and A. Cdre. C. D. C. Boyce, C.B., C.B.E. (A.O.C., Cyprus).

R.A.A.F. Promotions

THE R.A.A.F. New Year Promotion List included the following senior ranks: *To Air Commodore:* G/C. (acting air commodore) W. H. Garing, C.B.E., D.F.C., Commandant, R.A.A.F. Staff College, Point Cook; G/C. G. C. Hartnell, C.B.E., Director of Air Staff Plans and Policy. *To Group Captains:* W/C. I. S. Podger, D.F.C., Senior R.A.A.F. Officer in Japan; W/C. A. E. L. Davies; W/C. C. F. Read; W/C. R. N. Dalkin, D.F.C., Commandant, R.A.A.F. College (Cadets) Point Cook; W/C. I. J. Roberts, Staff Officer to C.A.S.

Half-yearly Promotions

THE following list of R.A.F. half-yearly promotions continues that published in our issue of January 6th:—

Air Commodore to Air Vice-Marshal.—*General Duties Branch:* W. P. G. Pretty, C.B.E. (Act. A.V-M.); K. B. B. Cross, C.B., C.B.E., D.S.O., D.F.C.; M. L. Heath, O.B.E. (Act. A.V-M.). *Technical Branch:* P. S. Blockey, C.B., C.B.E., B.A., M.I.Mech.E. (Act. A.V-M.). *Equipment Branch:* G. L. Worthington, C.B.E. (Act. A.V-M.). *Medical Branch:* P. B. L. Potter, C.B.E., M.D., Ch.B., D.P.H., D.T.M. and H., Q.H.S. (Act. A.V-M.).

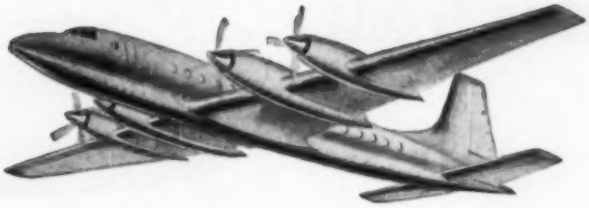
Group Captain to Air Vice-Marshal.—*Education Branch:* A. C. Kermode, O.B.E., M.A., F.R.Ae.S., A.D.C. (Act. A.V-M.).

Group Captain to Air Commodore.—*General Duties Branch:* P. H. Hamley, A.F.C.; M. H. Dwyer, C.B.E.; T. A. B. Parselle, C.B.E.; S. C. Elworthy, C.B.E., D.S.O., M.V.O., D.F.C., A.F.C.; D. R. Evans, C.B., C.B.E., D.F.C.; J. Grandy, D.S.O. *Technical Branch:* C. E. Hartley; J. Mutch, C.B.E.; C. L. Dann, C.B.E., B.Sc., F.R.Ae.S. *Medical Branch:* J. Magner, M.D., B.Ch.

Wing Commander to Group Captain.—*General Duties Branch:* J. S. Laird, O.B.E.; W. H. Tremear; L. M. Laws; K. J. Mellor, D.S.O., D.F.C.; A. J. Trumble, O.B.E.; R. D. Stubbs, D.F.C.; P. R. Walker, D.S.O., D.F.C.; P. R. Beare, D.S.O., D.F.C.; D. D. Rogers, O.B.E.; K. J. McDonald, O.B.E., D.F.C.; F. Hume; E. G. L. Millington, C.B.E., D.F.C.; B. R. Macnamara, D.S.O.; E. J. Morris, D.S.O., D.F.C.; T. W. Kean, A.F.C.; D. G. Lyster, D.S.O., D.F.C., A.F.C.; W. Carter, D.F.C. *Technical Branch:* R. G. Stone; J. C. Pope, A.F.R.Ae.S.; L. D. Dadswell, B.Sc.(Eng.), D.I.C.; S. C. W. Rudd, M.B.E.; S. W. Lane, M.B.E., A.M.I.Mech.E., A.F.R.Ae.S.; G. C. Godfrey, M.B.E. *Equipment Branch:* F. B. King; A. Selby. *Secretarial Branch:* F. S. Wakeham; C. W. S. Jones, A.C.A.; P. H. Roscoe, A.C.A.

Squadron Leader to Wing Commander.—*General Duties Branch:* R. B. Lord, A.F.C.; G. L. Mattey, D.F.C., A.F.C.; A. P. Smallman, D.S.O., A.F.C.; R. Broadbent, D.F.C.; J. R. Musgrave, D.S.O.; R. F. T. Doe, D.S.O., D.F.C.; R. S. Boast, D.F.C.; W. M. Dixon, D.S.O., D.F.C.; A. F. Wallace, O.B.E., D.F.C.; M. A. Ensor, D.S.O., D.F.C., A.F.C.; V. S. H. Duclos, D.F.C.; F. G. Woolley, D.F.C.; B. G. Frow, D.S.O., D.F.C.; J. H. Johnson, D.F.C.; D. F. B. Sheen, D.F.C.; A. J. Picknett, D.F.C.; N. Cameron, D.S.O., D.F.C.; J. C. Hutton, D.F.C.; H. M. S. Green; R. B. Cole, D.F.C., A.F.C.; J. Finch, O.B.E., D.F.C., A.F.C.; T. W. Horton, D.S.O., D.F.C.; K. G. Hubbard, O.B.E., D.F.C.; R. Aytoun, D.F.C.; K. McK. Murray, D.F.C.; L. A. Malins, D.S.O., D.F.C.; W. Laing, A.F.C.; D. Clare, D.F.C.; A. G. Conway, D.F.C.; F. Ruskell, D.F.C.; K. W. T. Pugh, A.F.C.; O. J. Wells; J. A. Bush, D.F.C.; D. K. Warburton, A.F.C.; K. C. Giddings, O.B.E., D.F.C., A.F.C.; P. A. H. McKeand, D.S.O., D.F.C., A.F.C.; I. G. Broom, D.S.O., D.F.C.; H. L. Lewis; P. H. Stembridge, D.F.C., A.F.C. *Technical Branch:* H. R. Crowley; W. H. Webber; J. H. I. Stirling; F. Parvin; E. H. Maule, A.F.R.Ae.S.; J. B. Evans; A. D. Miller, A.F.R.Ae.S.; R. Brown, M.B.E., D.F.M., A.F.R.Ae.S.; S. F. Kettell; C. A. H. Goudie, B.Sc.; H. J. Knevitt, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S., A.C.G.I., D.C.Ae.; R. E. W. Harland, M.A., A.M.I.Mech.E., A.F.R.Ae.S.; W. E. French, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S.; D. W. Densham, B.Sc., A.M.I.E.E., A.R.C.S., Dip. El.; J. R. Burges, B.Sc.; C. S. Betts, M.A.; J. E. Frith, B.Sc., A.M.I.E.E., Dip. El.; A. W. Eyre, B.Sc.(Eng.), A.R.S.M.; S. J. Peters; E. D. Smith, B.Sc.; I. D. H. Gibbins, M.B.E., B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S., A.C.G.I., D.C.Ae.; C. T. Nance, M.A., A.M.I.Mech.E., A.F.R.Ae.S.; C. N. S. Pringle, M.A., A.F.R.Ae.S.; E. J. Penton-Voak, B.Sc.(Eng.), A.F.R.Ae.S. *Equipment Branch:* R. L. Browning; C. D. Burrill; J. W. Lovell; G. R. Cook; J. C. Cracroft-Rice; P. L. Hancox, O.B.E.; E. G. F. Hill. *Secretarial Branch:* E. R. H. Caven, A.S.A.A.; W. C. Chadwick; A. C. Smith, A.S.A.A.; S. Robinson, A.C.A.; R. W. Jeary; P. Duxfield; G. Davidson; S. Findlay, M.B.E.; G. A. Potter, O.B.E.; T. Phillips. *Squadron Officer to Wing Officer, W.R.A.F.:* B. G. Martin; F. R. Pentland.

Royal Air Force Regiment (Squadron Leader to Wing Commander).—C. H. Baker; D. A. Pocock. *Medical Branch:* K. R. Hudson, M.B., B.S., M.R.C.O.G.; J. M. Urquhart, M.B., Ch.B., D.P.H.; S. M. Rigg, M.B., Ch.B.; E. S. Odbert, M.B.E., M.B., B.Ch. *Dental Branch:* P. A. Askew, B. D. S.; D. F. G. Macleod, L.D.S.; W. D. Sinclair, L.D.S. *Education Branch:* W. Thomson, B.Sc., A.M.I.Mech.E.; R. Duckett, B.Sc. *Provost Branch:* A. W. Pink.



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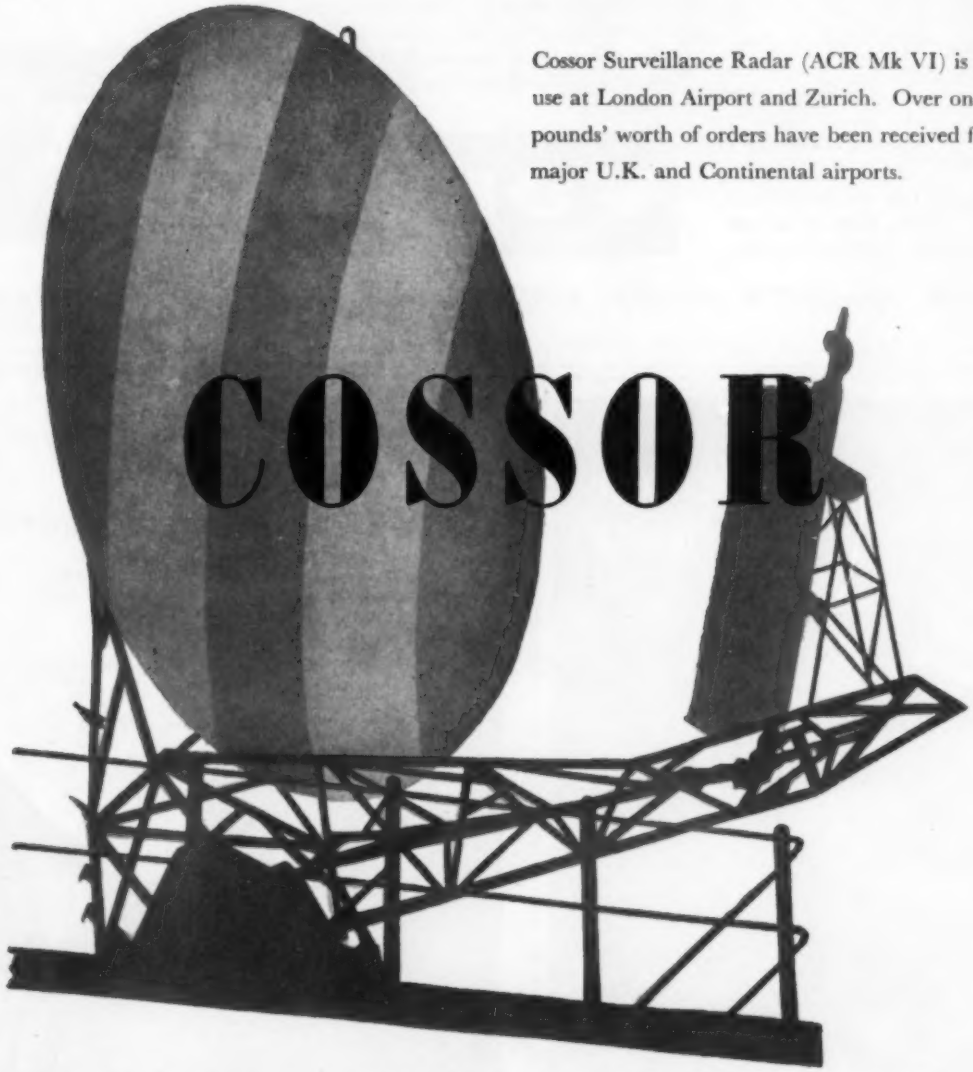

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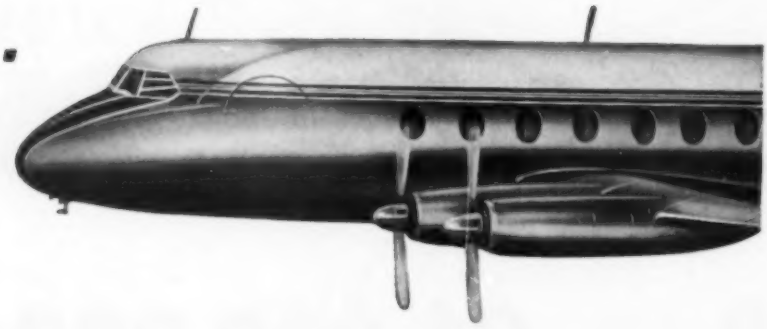

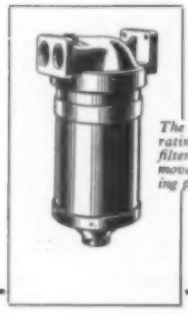

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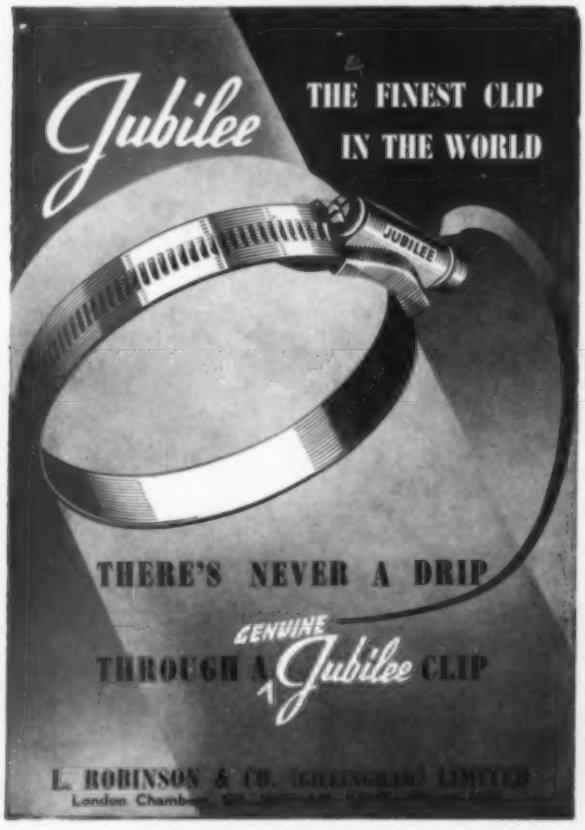

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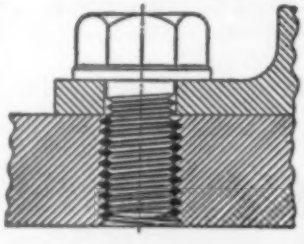

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Senior Representative (AP.43)
Department of Supply,
Australia House,
Strand,
London, W.C.2

with whom applications should be lodged by 6/2/56. [4714

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ERIC J. WAGGOTT,
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MINISTRY of Supply, National Gas Turbine Establishment, near Farnborough, Hants, requires engineers, mathematicians and physicists, with a 1st or 2nd class honours degree or equivalent qualification. Small number of houses available for married staff. Salary within scientific officer range £488 10s.—£885 (superannuable). Equal pay scheme. Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1., quoting C 661/5A/EY. [4717

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 257/3. From Airviews, Ltd., of Manchester Airport, Wythenshawe, Manchester, for an Amendment to the U.K. Internal Service which the Company are approved to operate between Manchester (Ringway) and the Isle of Wight (Bembridge) via Southampton (Eastleigh) (optional stop) during the season from April to October, 1956, so as to increase the frequency at present authorised to up to five return flights weekly.

APPLICATION No. 698. From B.K.S. Air Transport, Ltd., of 1, Marylebone High Street, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Dakota and Viking aircraft in conjunction with Swiss Air Express for the carriage of passengers and supplementary freight between Southend and Geneva at a frequency of two return flights weekly, to be operated on Saturdays, Sundays or Mondays, during the season from April to October inclusive each year for a period of seven years commencing 1st May, 1956.

APPLICATION No. 699. From Hunting-Clan Air Transport, Ltd., of 72, Wigmore Street, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Viking aircraft in conjunction with Wayfarers Travel Agency, Ltd., for Members of the Holiday Fellowship, Ltd., and the Co-operative Holidays Association, for the carriage of passengers between London Airport and Nice at a frequency of one return flight fortnightly, to be operated on Sundays during the period from 10th June to 2nd September, 1956, inclusive.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [4778

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L-5 Aircraft	One	Civil Aerodrome, Patna (India).

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INDEX TO ADVERTISERS

	Page
Aero Research, Ltd.	16
Air Trainers, Ltd.	13
Alvis, Ltd.	23
Armstrong Siddeley Motors, Ltd.	21
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	42
Auster Aircraft, Ltd.	47
"Autocar, The"	38
Belfast Ropework Co., Ltd., The	39
Blackburn and General Aircraft, Ltd.	3
Box No. 8706	44
Box No. AC. 15066	48
Bristol Aeroplane Co., Ltd., The	26
Bristol Aircraft, Ltd.	Cover iv
British Aviation Services, Ltd.	47
British European Airways	20
British Messier, Ltd.	19
Brooklands Aviation, Ltd.	43
Brown Corporation (Sales), Ltd., David	34
Burnley Aircraft Products, Ltd.	32
Carr Fastener Co., Ltd., The	12
Central Office of Information (R.A.F.)	24, 25
Cossor Group of Companies, The	35
Counting Instruments, Ltd.	36
Cross Manufacturing Co. (1938), Ltd.	40
Curd Components, Ltd.	42
De Havilland Aircraft Co., Ltd.	22
De Havilland Propellers, Ltd.	47
Derby Aviation, Ltd.	40
Docker Brothers	4
Dowty Equipment, Ltd.	48
Dunlop Rubber Co., Ltd., The	18, 41
Eagle Aviation, Ltd.	47
Ekco Electronics, Ltd.	27
English Electric Co., Ltd., The	29, 42, 43, 47, 48
Fairey Aviation Co., Ltd., The	Cover i
Ferranti, Ltd.	5
Fibreglass, Ltd.	28
Garringtons, Ltd.	Cover iii
General Electric Co., Ltd., The	8
Gloster Aircraft Co., Ltd.	43, 45, 46
Goodmans Industries, Ltd.	9
Hobson, Ltd., H. M.	41
Hymatic Engineering Co., Ltd., The	11
Iliffe and Sons, Ltd.	38
Kelvin and Hughes (Aviation) Ltd.	Cover ii
Lewis, Ltd., D.	40
Lucas (Gas Turbine Equipment), Ltd. Joseph	15, 42
Marconi's Wireless Telegraph Co., Ltd.	33
Marshall's Flying School, Ltd.	43, 45
Napier and Son, Ltd., D.	17
National Institute of Engineering	40
Plessey Co., Ltd., The	31
Ransome and Marles Bearing Co., Ltd.	2
Rists Wires and Cables, Ltd.	10
Robinson and Co. (Gillingham), Ltd., L.	36
Roe and Co., Ltd., A. V.	14
Rotax, Ltd.	37, 39, 44
Rubery Owen and Co., Ltd.	12
Sangamo Weston, Ltd.	34
Saunders-Roe, Ltd.	43
Scintilla, Ltd.	38
Shell-Mex and B.P., Ltd.	30
Short Brothers and Harland, Ltd.	1, 39, 45, 46
Simmonds Aerocessories, Ltd.	7
Skyways, Ltd.	43
Sorbo, Ltd.	38
Teddington Aircraft Controls, Ltd.	10
Teleflex Products, Ltd.	8
Thompson Brothers (Bilston), Ltd.	6
Triplex Safety Glass Co., Ltd.	37
Vokes, Ltd.	36

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